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Fisheries Research Bulletin No. 24

Distribution and Abundance of Fish Eggs and Larvae from the Spring and Summer Plankton of North-east New Zealand, 1976–78

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by

J. Crossland

Fisheries Research Division
New Zealand Ministry of Agriculture and Fisheries

Distribution and Abundance of Fish Eggs and Larvae from the Spring and Summer Plankton of North-east New Zealand, 1976–78

Frontispiece: Preserving the catch.

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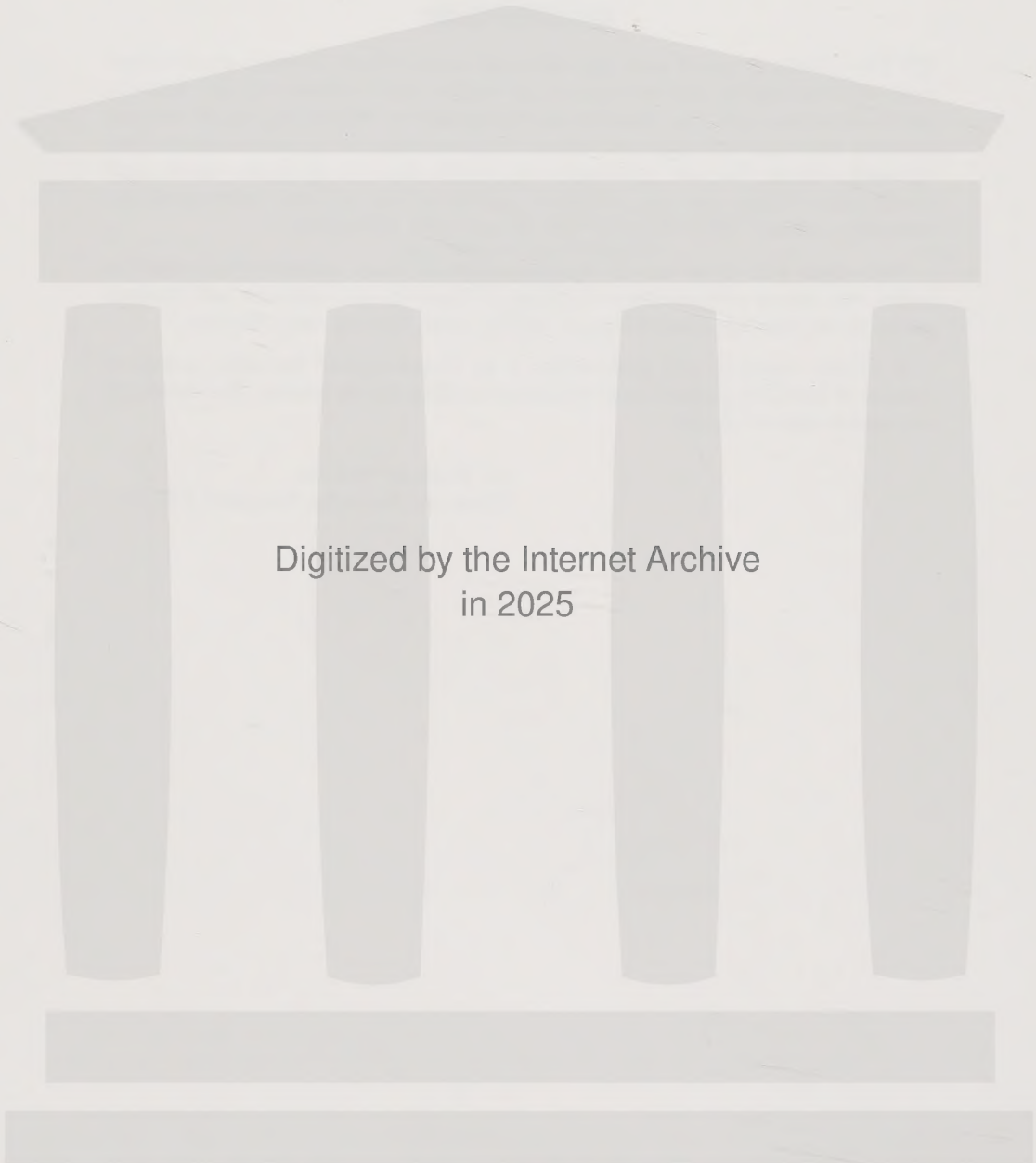
FOREWORD

UNTIL about 15 years ago New Zealand was virtually devoid of published data and descriptive information on its marine ichthyofauna. In this bulletin James Crossland not only extends our knowledge by identifying and describing hitherto unrecognised eggs and larvae of various species in north-eastern New Zealand waters, but also provides quantitative data on their abundance and distribution. These, in turn, make it possible to derive some information on spawning seasons and areas as well as on stock abundance.

Such data will be of use for future studies on those species which may be either the source of additional commercial fisheries or important and integral parts of the marine ecosystems on which such fisheries may depend.

A further value of this publication is its illustration of the wide variety of species of both subtropical and temperate origins which inhabit the waters off our north-eastern coast.

G. DUNCAN WAUGH,
Director, Fisheries Research Division



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ABSTRACT

This publication presents the results of plankton sampling cruises in the outer Hauraki Gulf in December 1976 and February 1978 and off east Northland in October and December 1977. Stations were sampled by oblique tows of a cylinder-cone plankton net. Each sample was sorted for eggs and larvae. Totals of 197 000 eggs and 24 000 larvae were collected at 29 stations in the outer Hauraki Gulf; and 51 000 eggs and 42 000 larvae were taken at 40 stations off east Northland. Twenty-nine kinds of eggs and 45 kinds of larvae were recognised from at least 35 families of teleost fishes. The distribution, seasonality, and abundance of each species are discussed separately. Identifications and descriptions are provided for previously unrecorded eggs and larvae. The outer Hauraki Gulf was found to be an important spawning ground for many species. Off east Northland the spawning of snapper and jack mackerel was thought to have been inhibited by the below average sea temperatures during the spring of 1977. Larval drift in the outer Hauraki Gulf was affected by the south-setting East Auckland Current. An offshore drift, which was probably wind induced, was recorded off east Northland.

INTRODUCTION

Much information is available from plankton surveys of the spawning of snapper (*Chrysophrys auratus*) in the Hauraki Gulf (Cassie 1956a, Crossland 1980) and other species in that area (Colman 1973, Crossland 1981). However, there are no other published studies on fish eggs and larvae of northern New Zealand. This study was designed to extend knowledge of the distribution of ichthyoplankton around the north-east coast of the North Island. Four cruises were planned to coincide with the expected spawning season of snapper, the principal commercial species of the area. The main aims of the study were to locate spawning areas and determine spawning periods of snapper and other species of economic importance, and to provide identifications and descriptions of eggs and larvae not recorded in the published literature.

STUDY AREA

The study area (Fig. 1) has a deeply indented coastline with many large bays and harbours. In parts the sea bed is clear and sandy, but extensive areas between Bream Head and Cape Karikari, and east of Great Barrier Island, are uneven with large patches of reef. These diverse habitats support a wide variety of demersal and pelagic fishes. Doak (1972) recorded 96 species representing 44 families around the Poor Knights Islands off east Northland, Russell (1969) 62 species from 39 families around Goat Island (off Cape Rodney), and Willan, Dollimore, and Nicholson (1979) 64 species from 33 families off Karikari Peninsula, east Northland.

The study area was sampled in 2 parts. Two cruises were made in the Hauraki Gulf (12–16 December 1976 and 31 January–6 February 1978), where 29 stations were worked (Fig. 2). Two of these stations were in the inner gulf, in an area known to be an important spawning ground of snapper and other species, and they were sampled for comparison with stations in the outer gulf. Two cruises were also made off east Northland (25–31 October and 12–18 December 1977), where 40 stations were worked (Fig. 3).

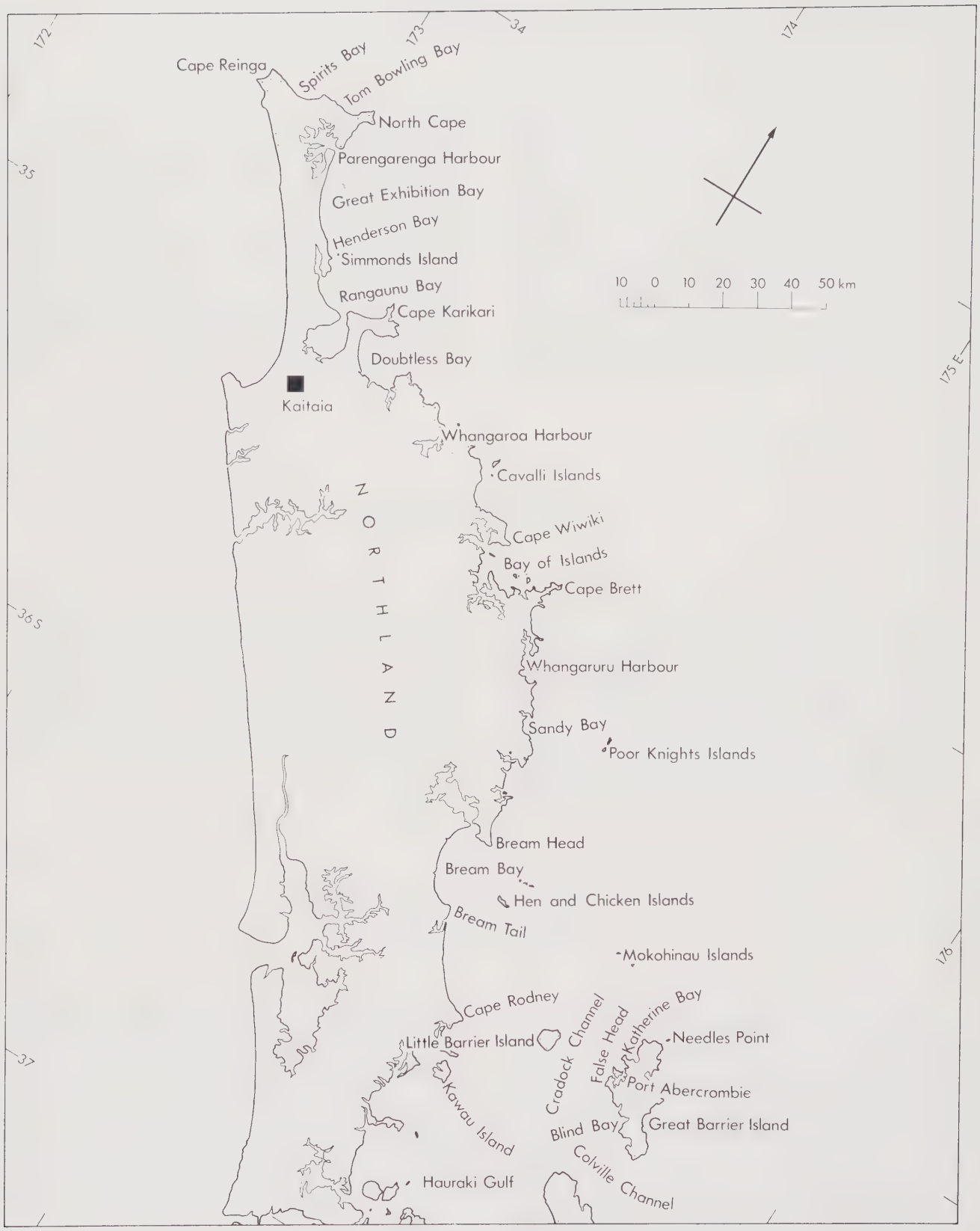


Fig. 1: The study area, showing places mentioned in the text.

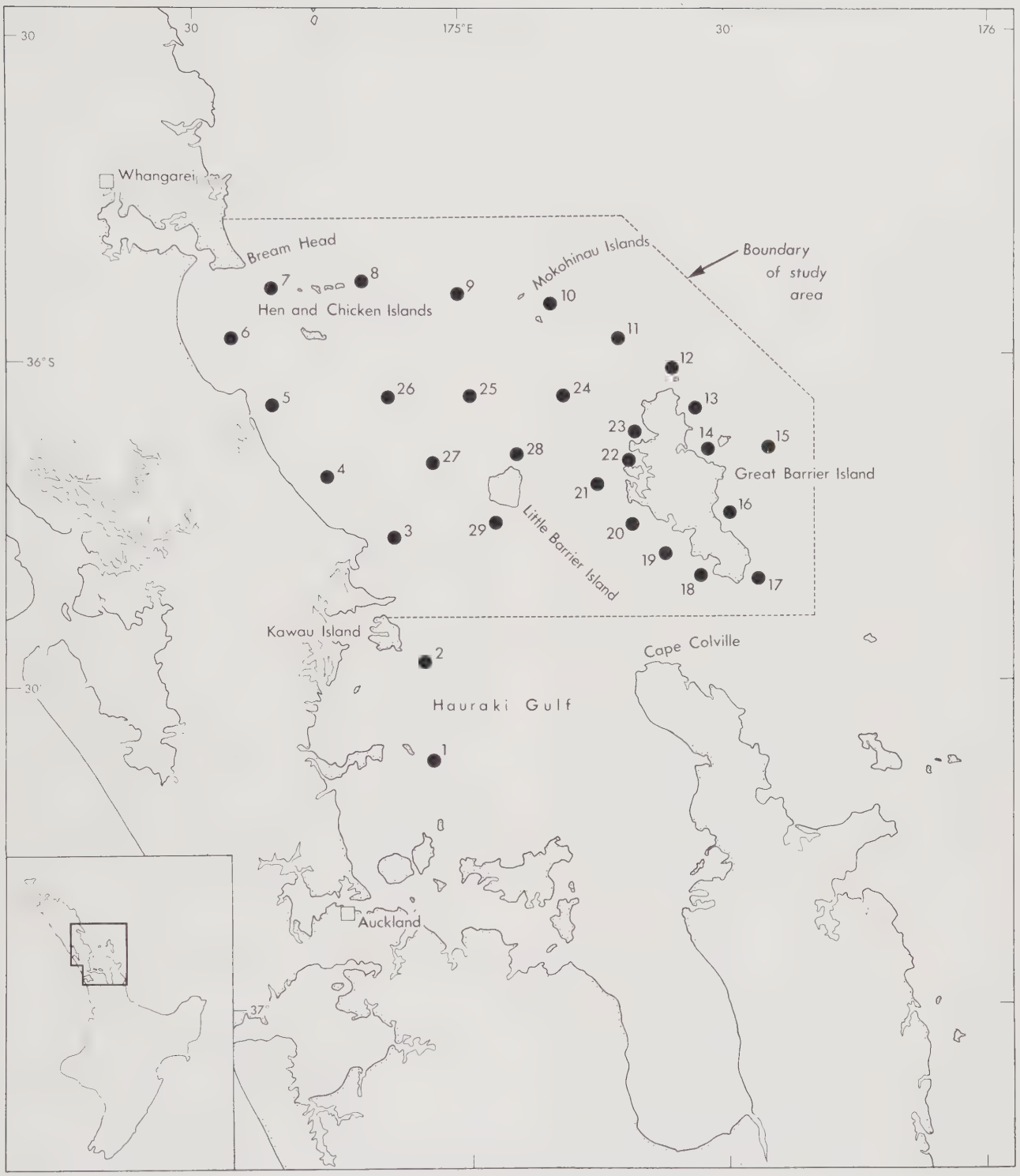


Fig. 2: Sampling stations in the outer Hauraki Gulf.

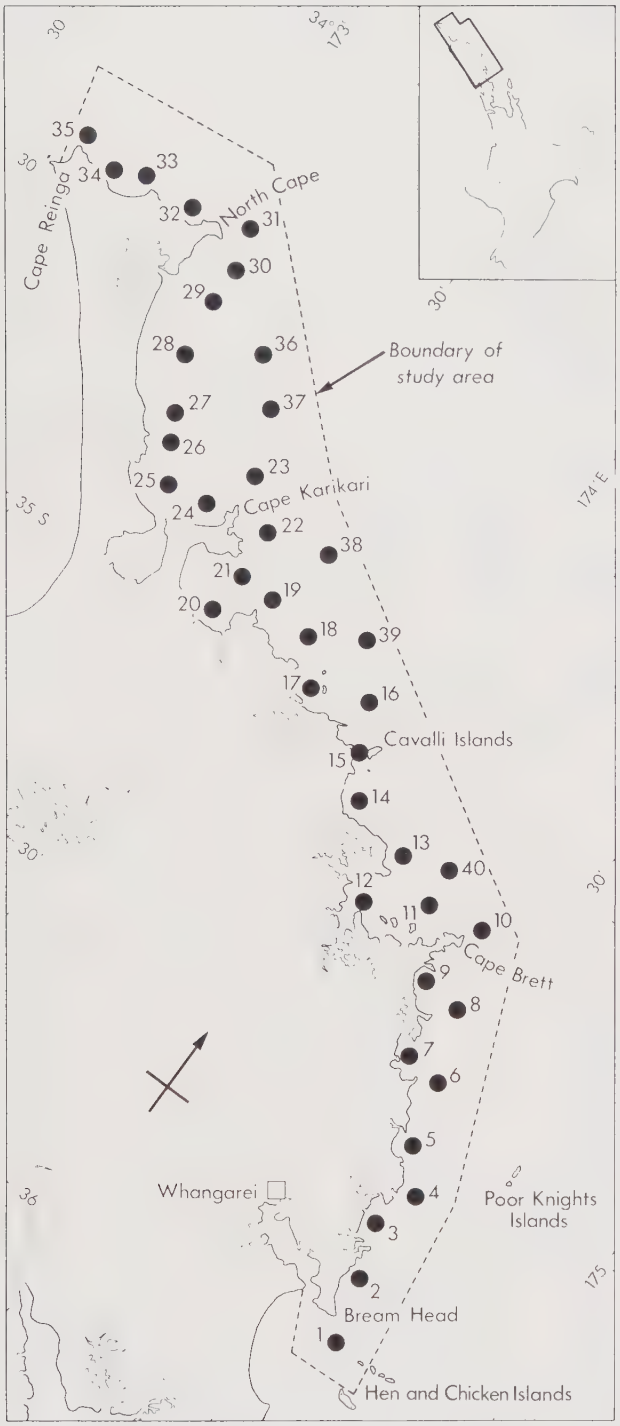


Fig. 3: Sampling stations off east Northland.

MATERIAL AND METHODS

SAMPLING AND SORTING

Plankton samples were taken by oblique tows of a cylinder-cone net. Details of the net were: mouth area 0.25 m^2; cylinder 56 cm diameter by 150 cm long; cone slope length 185 cm; gauze 0.425-mm aperture with a porosity of 47%. The total filtering area was 2.225 m^2 and the filtering area to mouth area ratio was 8.9:1, made up of 5.35 in the cylinder and 3.55 in the cone. The volume of water sampled (range 87–760 m^3) was recorded with a digital flow meter, type 2030 by General Oceanics, Inc., which was mounted at a distance of a quarter the diameter from the rim of the net. Tows were made at a boat speed of 2.0–2.5 knots, with the net usually descending to within 5–10 m of the bottom. Further information on the sampling technique is given by Crossland (1980).

Sampling was done during daylight except on the second cruise in the outer Hauraki Gulf, when stations 13, 14, and 15 were sampled both day and night.

Samples were preserved in 5% neutralised formalin. Sorting was done under a stereo microscope at a magnification of ×12. The common types of eggs and larvae were counted *in situ*. Less common types and those previously unrecorded were removed for later counting, identification, and description. Large samples were divided with a Folsom splitter until a manageable fraction was obtained. When eggs were abundant, but larvae were not, eggs were subsampled, and the whole sample was then sorted for larvae. When larvae were more abundant, these were subsampled, and the whole sample was sorted for eggs.

IDENTIFICATION OF EGGS AND LARVAE

About two-thirds of egg and larval types were identified to species by use of published descriptions. Some of the remainder could be identified to family or genus, but others were not recognised, though some tentative identifications have been suggested. Undescribed larvae often could be identified by their likeness to the juvenile or adult. Others were identified by building up a developmental series. Larvae of some species were identified by their similarity to those of related species which had been described from other parts of the world. Knowledge of the distribution, abundance, and spawning periods of fish occurring locally was also used to assist identification.

Larval lengths recorded were notochord length (NL) in small specimens and standard length (SL) in larger ones.

SEA TEMPERATURE OBSERVATIONS

The sea surface temperature (± 0.1 °C) was taken by bucket and mercury thermometer at each station. The sample was from undisturbed water (that is, outside the boat's wake) in the top 30 cm. In addition, bathythermograph casts were made at each station on the 2 cruises off east Northland and the second cruise in the outer Hauraki Gulf.

RESULTS

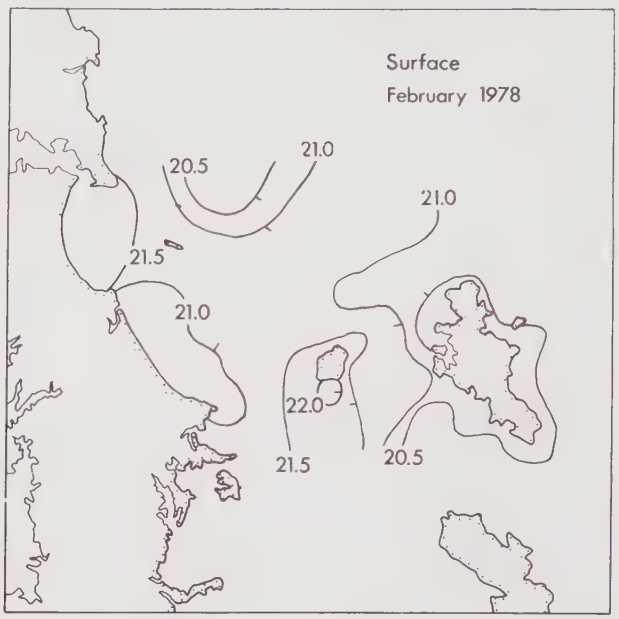
SEA TEMPERATURES

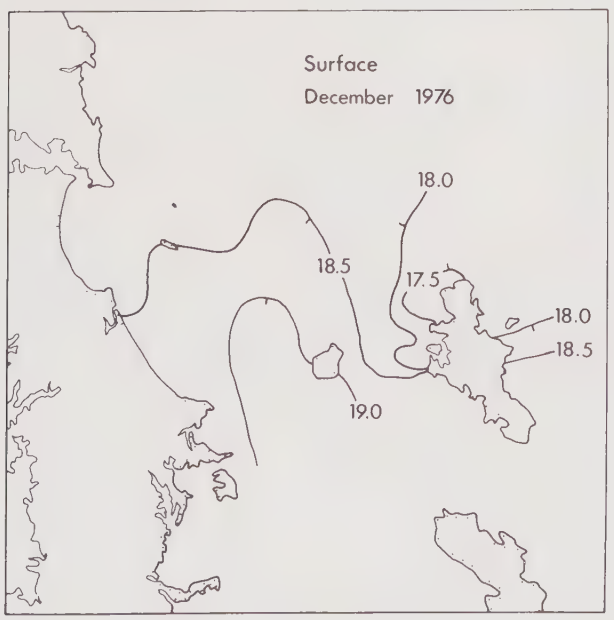
Surface temperatures in the outer Hauraki Gulf (Fig. 4) ranged from 17.0 to 19.2 °C on the December 1976 cruise and from 20.3 to 22.1 °C on the February 1978 cruise. The warmest waters were south of Little Barrier Island and in Bream Bay. The lowest temperatures were recorded off Needles Point at the northern tip of Great Barrier Island and in Katherine Bay. This area is probably influenced by oceanic water entering the Hauraki Gulf through Cradock Channel on the southward setting flood tide. The flood tide also enters through Colville Channel, sets westwards and then north-west following the shore of Great Barrier Island, and meets the opposing tidal stream near False Head. The effects of this on water temperatures can be seen in Fig. 4.

Sea bottom temperatures (Fig. 4) during the second cruise ranged from 13.2 to 18.1 °C. The shape of the isotherms in the north of the study area reflected the changing water depth, with the 14.0 °C isotherm corresponding to the 100-m isobath. The highest bottom temperatures occurred around Little Barrier Island. They were higher than those at the 2 stations in the inner gulf, an unexpected and unexplained result.

Temperature profiles showed that the water was almost isothermal down to a depth of about 20 m, below which the temperature dropped, but rarely with a sharp thermocline.

Surface temperatures off east Northland ranged from 14.5 to 15.8 °C during the October 1977 cruise





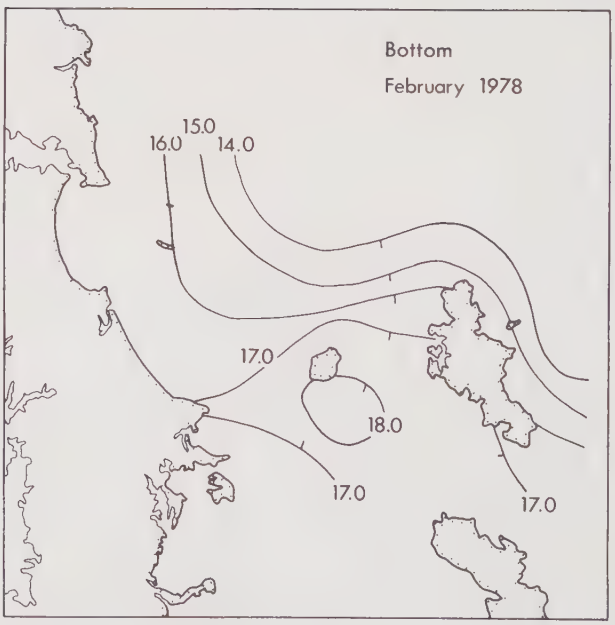


Fig. 4: Sea temperatures (°C) in the outer Hauraki Gulf.

(Fig. 5). The highest temperatures were recorded off Great Exhibition Bay at the 2 outer stations (36 and 37). In December 1977 the range was from 14.8 to 17.2 °C, with the highest recordings in the Bay of Islands and Doubtless Bay. These data show that the 1977 spring was unseasonably cold when compared with the data of Mercer (1979), who recorded surface temperatures of 15.7–16.6 °C in October 1974 and 16.3–19.4 °C in November 1973.

Bottom temperatures during October 1977 (Fig. 5) ranged from 13.7 to 16.0 °C, but recordings could not be made at the 5 deepest stations (36–40) because a deep-water bathythermograph was not available. The highest bottom temperature (16.0 °C) was recorded off Parengarenga Harbour and was higher than any surface temperature. On the December 1977 cruise bottom temperatures, which ranged from 11.8 to 15.8 °C, were lower in most of the study area. The lowest temperatures were recorded at 2 of the deepest stations (36 and 37) off Great Exhibition Bay. The only area to show a distinct rise in bottom temperatures was the Bay of Islands, which had also recorded the highest surface temperatures.

Fig. 5: Sea temperatures (°C) off east Northland.

Temperature profiles on the October 1977 cruise showed a weak thermocline at a depth of 20–30 m at some of the stations, mostly north of Whangaroa Harbour. Results from the December 1977 cruise showed variable profiles. At stations 12, 20, and 26 there were strong thermoclines, and at stations 16 and 36 there were 3 discontinuities. The thermocline depth varied greatly and was sometimes only 3–5 m below the surface. At most of the other stations there was a gradual decrease in temperature towards the bottom.

In the above results no allowance has been made for diurnal temperature variation. During the first cruise in the outer Hauraki Gulf and both Northland cruises the weather was mostly overcast with strong winds; so little diurnal effect is likely. However, during the fourth cruise the weather was fine and temperatures at the 3 night stations were 0.9–1.0 °C lower than the corresponding values during the day.

EGGS AND LARVAE

A total of 139 samples was collected and these contained 248 000 eggs and 66 000 larvae (Table 1). All samples contained eggs and all except 1 contained larvae. The maximum number of eggs taken in a single haul was 61 000 (at station 7 off Bream Head in December 1976), and that of larvae was 5200 (at station 32 in Tom Bowling Bay in October 1977).

Samples from the outer Hauraki Gulf contained the eggs and larvae of several species in large numbers. The principal egg types were snapper, jack mackerel *Trachurus novaezelandiae*, blue mackerel (*Scomber australasicus*), anchovy (*Engraulis australis*), and leather jacket (*Novodon convexirostris*). The most abundant larvae were anchovy, *T. novaezelandiae*, blue mackerel, snapper, and pilchard (*Sardinops neopilchardus*) and blenny (families Blenniidae, Clinidae, and Tripterygiidae) in December 1976.

The spring ichthyoplankton off east Northland was dominated by pilchard eggs and larvae, and by blennioid larvae, mostly of the family Tripterygiidae. The proportion of larvae to eggs in these cruises was much greater than that in the outer Hauraki Gulf. This was because of the many pilchard larvae which originated from spawnings that occurred before sampling or outside the study area, and because of the abundance of blenny larvae (blenny eggs are demersal).

TABLE 1: Numbers of eggs and larvae collected on each cruise

	Outer Hauraki Gulf		East Northland	
	Dec 1976	Feb 1978	Oct 1977	Dec 1977
Eggs	149 000	48 000	43 000	8 000
Larvae	18 000	6 000	34 000	8 000

Twenty-nine kinds of eggs and 45 kinds of larvae were recognised from at least 35 families of teleost fishes (Table 2). Details of the densities of eggs and larvae at each station are in the Appendix. These data were collated and details of distribution, seasonality, and abundance for each species are given below. The arithmetic proportions between station counts were used to plot distribution maps (expressed as numbers below 10 m^2). In instances where the abundance of a particular egg or larva differed greatly in the 2 parts of the study area, different contour scales were used on the maps. Cruises not shown in the map series recorded fewer eggs and larvae than the minimum contour level for that species.

The species have been placed in phylogenetic sequence according to Nelson (1976).

Family Engraulidae

Anchovy *Engraulis australis* (White, 1790)

Eggs and larvae of New Zealand anchovy have been described by Robertson (1975) and Baker (1972), and they are well known components of the plankton. The only published information on spawning in New Zealand waters is for the inner Hauraki Gulf (Crossland 1981) and Hawke Bay (Bradford, Ridgway, Robertson, and Stanton 1980).

Outer Hauraki Gulf. Anchovy eggs were abundant in December 1976, mainly in the north-west of the study area (Fig. 6). The highest concentration was off Bream Head, and they were also common from the Hen and Chicken Islands to Little Barrier Island. In February 1978 they were much less abundant in the north, but were again common around Little Barrier Island and in Cradock Channel.

Larvae were very abundant and had similar distributions on both cruises (Fig. 7). They were common throughout the area, except in the north-east. The highest concentrations were near Little Barrier Island in December 1976 when they were more common than previously recorded (Crossland 1981). Several samples contained over 1000 larvae.*

East Northland. In October 1977 a few anchovy eggs were taken off Bream Head and between Whangaroa Harbour and Doubtless Bay. None were taken in December 1977. Larvae were recorded at 4 stations in October 1977. In December 1977 they were fairly common in the southern half of the study area (Fig. 8).

*See Tables 4–11 for details of where eggs and larvae were recorded.

TABLE 2: Kinds of eggs and larvae collected off north-east New Zealand, 1976–78

Species	Eggs	Larvae
Engraulis australis	✓	✓
Sardinops neopilchardus	✓	✓
Family Muraenidae (unidentified species*)	✓	✓
Gnathophis sp.	✓	
Maurolicus muelleri		✓
Family Myctophidae (3 unidentified species)		✓
Auchenoceros punctatus	✓	✓
Family Moridae (unidentified species)		✓
Cypselurus sp.		✓
Scomberesox saurus		✓
Paratrachichthys trailli	✓	
Family Trachichthyidae (unidentified species)		✓
Zeus faber	✓	✓
Hippocampus abdominalis		✓
Lissocampus filum		✓
Family Scorpaenidae (unidentified species)		✓
Chelidonichthys kumu	✓	✓
Acanthoclinus quadridactylus		✓
Trachurus novaezelandiae	✓	✓
T. declivis	✓	
Caranx georgianus		✓
Family Carangidae (unidentified species)		✓
Arripis trutta	✓	
Chrysophrys auratus	✓	✓
Cepola aotea		✓
Aldrichetta forsteri	✓	✓
Family Labridae (unidentified species†)	✓	✓
Coridodax pullus	✓	
Hemerocoetes sp.		✓
Limnichthys rendahli		✓
Tewara cranwellae		✓
Genyagnus monopterygius	✓	✓
Families Blenniidae, Clinidae, and Tripterygiidae (many unidentified species)		✓
Grahamichthys radiatus		✓
Thyrsites atun		✓
Lepidopus caudatus	✓	✓
Scomber australasicus	✓	✓
Family Gobiesocidae (2 unidentified species)		✓
Lophonectes gallus	✓	✓
Rhombosolea plebeia and *R. leporina*‡	✓	✓
Peltorhamphus latus§	✓	✓
Pelotretis flavilatus	✓	✓
Novodon convexirostris	✓	✓
Allomycterus jaculiferus		✓
Unidentified eggs (6 kinds)	✓	
Unidentified larvae (2 kinds)		✓

* eggs and larvae of 1 species and larvae of another.
† Probably several species, represented by both eggs and larvae.
‡ At the egg and larval stages these 2 species are not distinguishable.
§ Eggs of this species are probably not distinguisable from those of *Rhombosolea* spp.

Previous records of the spawning of anchovy in the Hauraki Gulf showed that they spawned close inshore in large bays. However, this study has shown that they can spawn further offshore and along unprotected coastlines such as the east side of Great Barrier Island. Sea temperatures on the east Northland cruises were well below the preferred spawning range of anchovy (18.5–20.5 °C) recorded by Crossland (1981); so few conclusions can be drawn from their spawning in this area. The small number of eggs and larvae which were taken were nearly all in the southern part, which perhaps suggests that anchovy are less common off east Northland than in the Hauraki Gulf.

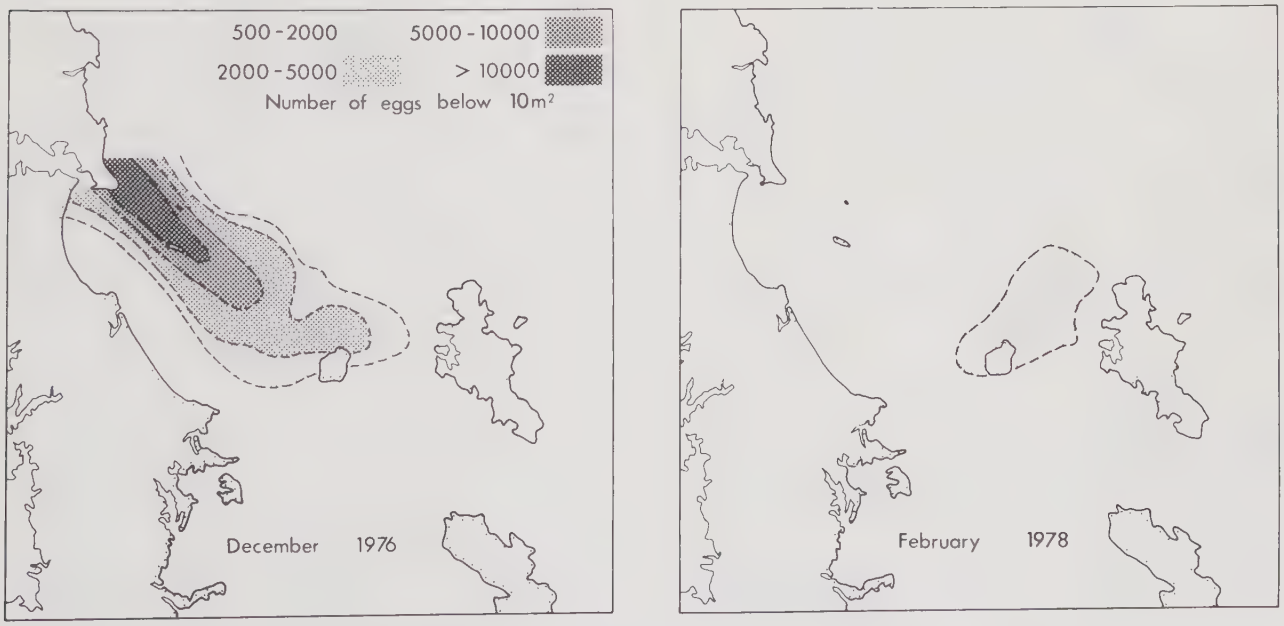


Fig. 6: Distribution of anchovy eggs in the outer Hauraki Gulf.

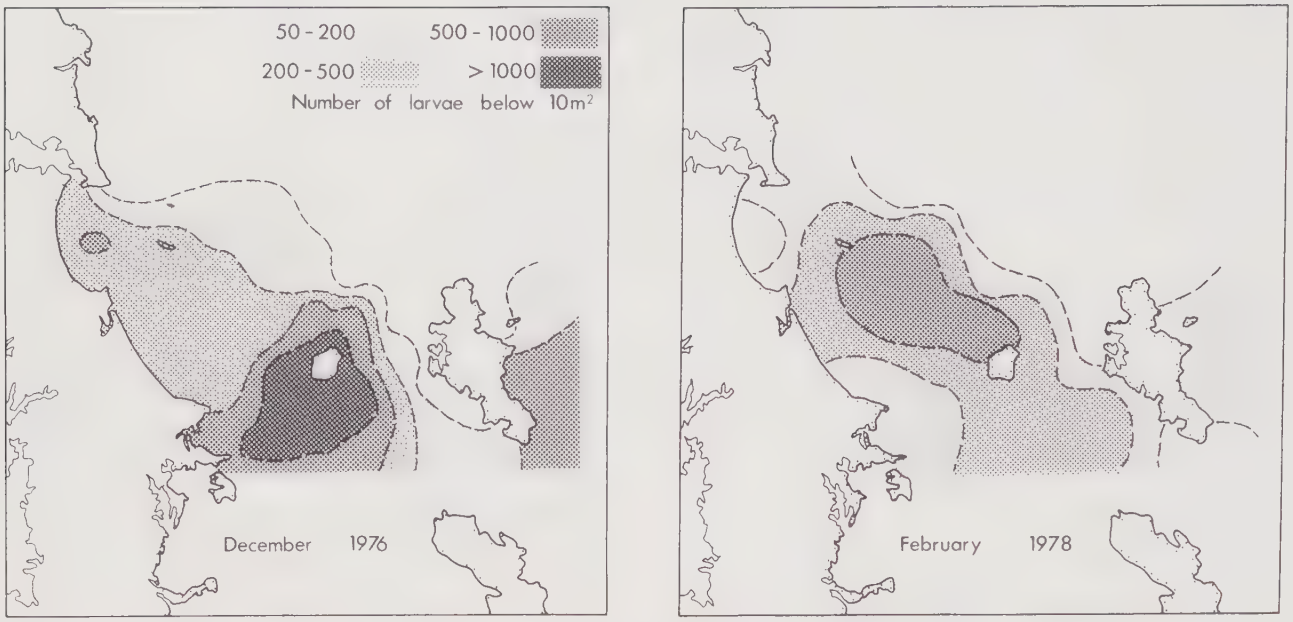


Fig. 7: Distribution of anchovy larvae in the outer Hauraki Gulf.

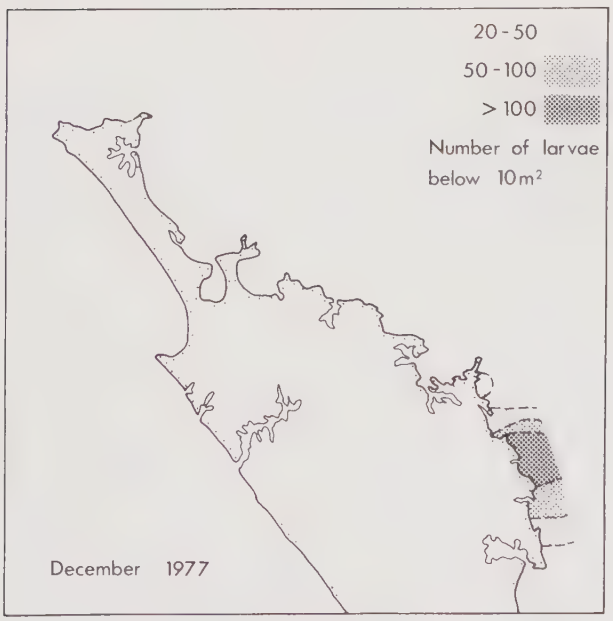


Fig. 8: Distribution of anchovy larvae off east Northland.

Outer Hauraki Gulf. During December 1976 there was a dense patch of eggs centred around the Hen and Chicken Islands (Fig. 9). Spawning again occurred near there in February 1978, but eggs were taken in quantity only at station 8.

Larvae were common during December 1976 (Fig. 10), particularly in Bream Bay and around Little Barrier Island. On the second cruise they were taken at only 3 stations.

East Northland. Eggs were common in October 1977, mainly in the southern half of the study area (Fig. 11). In December 1977 only a few eggs were taken, all at station 1.

Larvae occurred at every station in October 1977 (Fig. 12). Their numbers exceeded those of all other species recorded during this study and by Crossland (1981). The maximum number taken at a single station was 4200 in Tom Bowling Bay. In December 1977 they were not taken north of Cape Karikari, but were still common in the rest of the study area, though much less so than in October 1977.

Earlier studies (Baker 1972, Crossland 1981) found that peak spawning of pilchard occurred when the sea surface temperature was 16–17 °c. The results of the east Northland cruises in this study showed that heavy spawning took place at a significantly lower temperature (less than 15 °c and perhaps as low as 14 °c). Without long-term observations it is not possible to be certain when peak spawning occurred off east Northland in 1977, but the data strongly suggest that it was in the first half of October, or earlier.

Family Clupeidae

Pilchard *Sardinops neopilchardus* (Steindachner, 1879)

Previous records of eggs, larvae, or spawning are by Baker (1972), Robertson (1973, 1975), Crossland (1981), and Bradford, Ridgway, Robertson, and Stanton (1980).

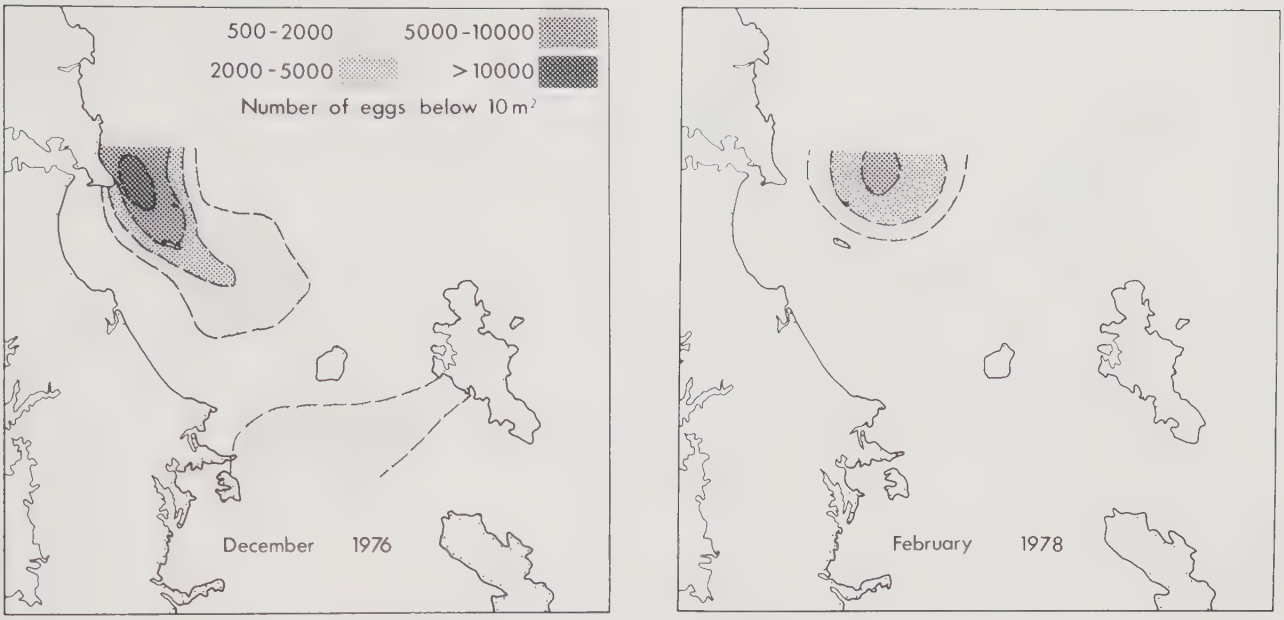


Fig. 9: Distribution of pilchard eggs in the outer Hauraki Gulf.

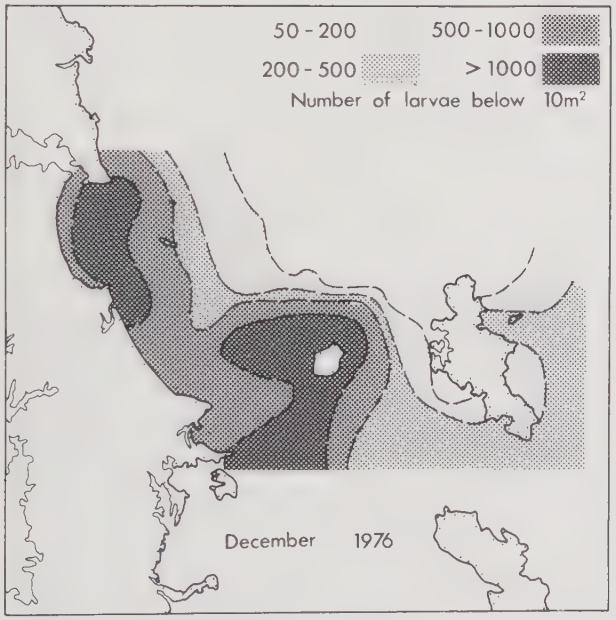


Fig. 10: Distribution of pilchard larvae in the outer Hauraki Gulf.

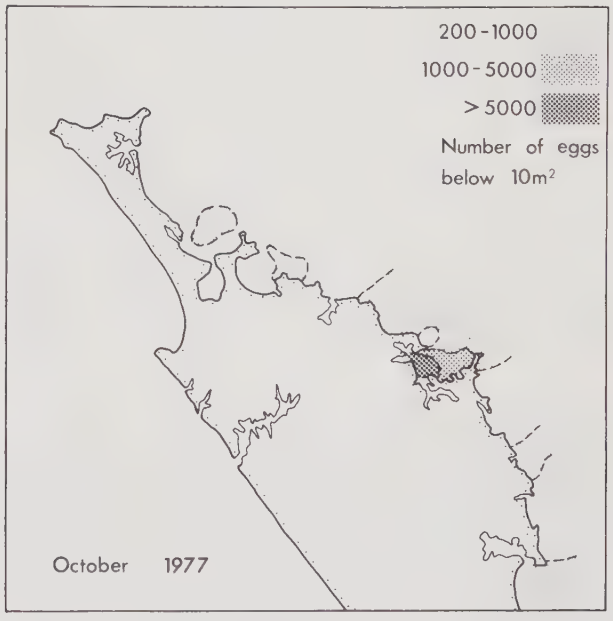


Fig. 11: Distribution of pilchard eggs off east Northland.

The other 2 cruises confirmed previous findings (Crossland 1981) that the main spawning ground in the Hauraki Gulf is in the outer gulf. Whereas the east Northland cruises recorded a lower minimum temperature in the range of peak spawning, the February 1978 data showed that isolated spawning bursts could occur at higher temperatures (20–21 °C) and much later in the season than previously recorded in northern New Zealand.

Knowledge of the temperature range of spawning, spawning areas, and spawning season of pilchard is incomplete and further study is needed. The high numbers of larvae taken off east Northland and in the Hauraki Gulf during this study, and also those taken in the Bay of Plenty (D. A. Robertson pers. comm.) suggest considerable stocks of this species, which is very lightly exploited.

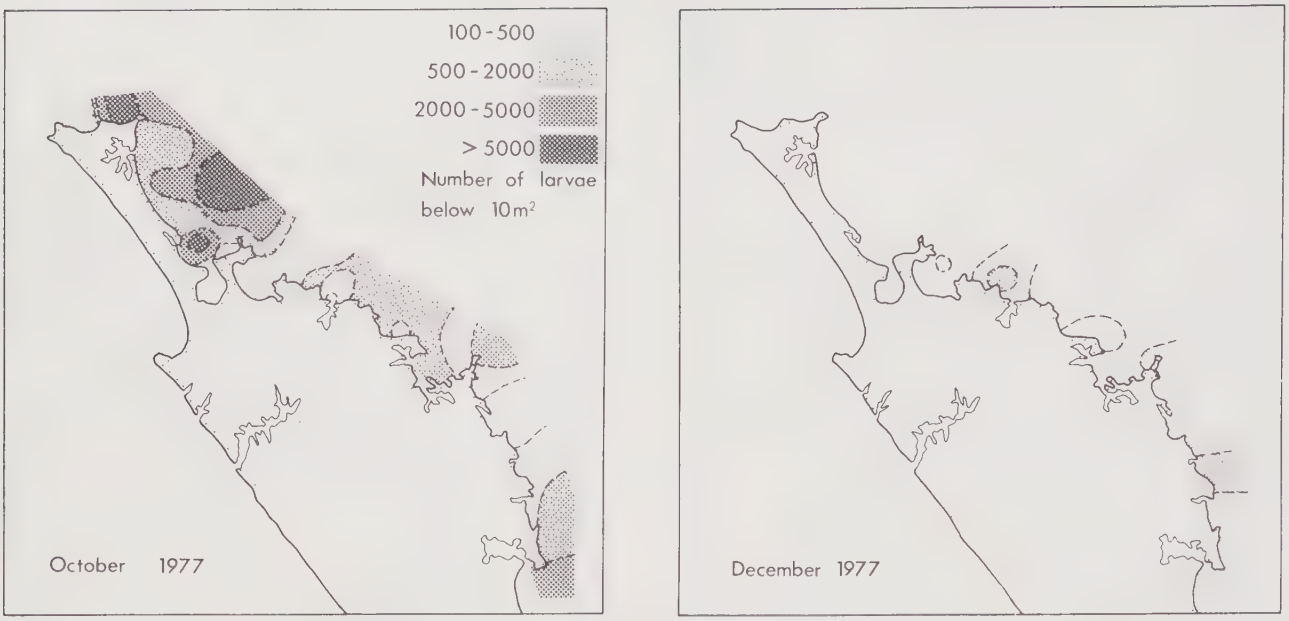


Fig. 12: Distribution of pilchard larvae off east Northland.

Family Muraenidae

Moray eel (unidentified species 1)

Eggs and larvae of this eel were first described by Crossland (1981).

Eggs of this type were recorded again during February 1978, when a few were taken at 15 stations in the outer Hauraki Gulf. The largest number in a single haul (64) was recorded off Bream Head.

Larvae were taken at 2 stations. During the same period several specimens of the commonest local species of moray, yellow moray (*Lycodontis prasinus* (Richardson, 1847)), were caught by hand-line at Great Barrier Island; all the females had well-developed ovaries and appeared to be total spawners.

These eggs and larvae were not recorded on the other cruises.

Moray eel (unidentified species 2)

In October 1977 another eel larva was taken at station 35 off Cape Reinga. This larva (Fig. 13) could be readily distinguished from the species above because its lower jaw was about twice as long as its upper jaw, its teeth were much longer, and it had 2 ventral pigment patches (not present in the other species) posterior to the anus.

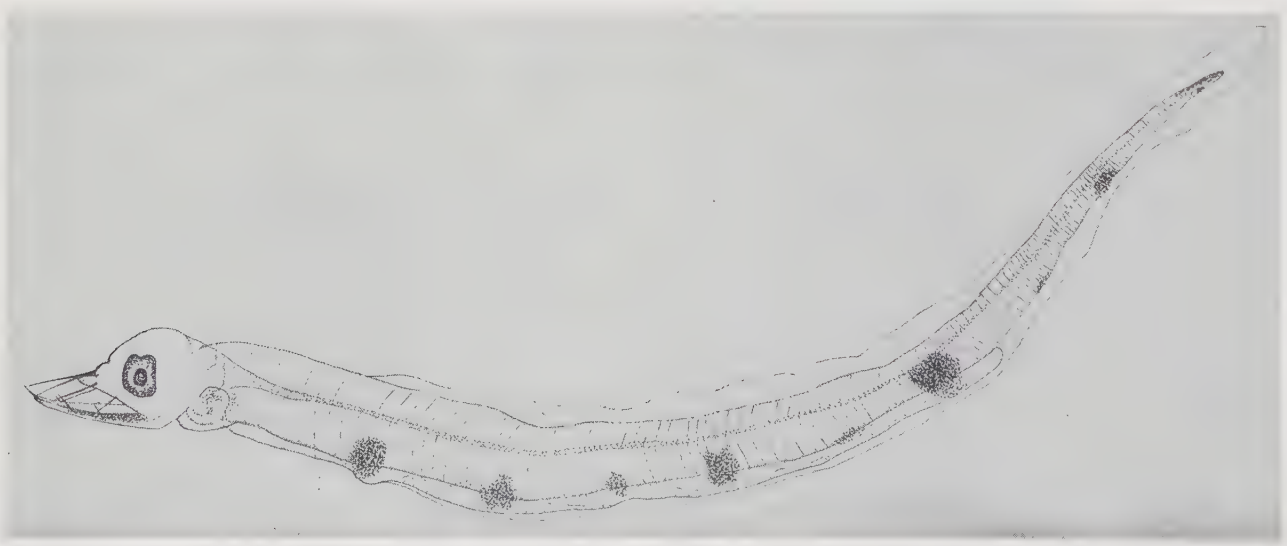


Fig. 13: Moray eel larva (13.6 mm SL).

Family Congridae

Sand eel *Gnathophis incognitus* Castle, 1963 or *G. habenatus* (Richardson, 1848)

A few eggs of *Gnathophis* sp. (described by Castle and Robertson 1974) were taken at 6 stations in the outer Hauraki Gulf in February 1978. They were much less common than moray eel eggs.

Family Sternoptychidae

Lightfish *Maurolicus muelleri* (Gmelin, 1789)

The planktonic stages of this small mesopelagic fish were described by Robertson (1976).

Four small larvae were taken at station 33 off east Northland in October 1977. A larger specimen (10.7 mm SL) was recorded off Great Exhibition Bay in December 1977.

Family Myctophidae

Lanternfish

During the cruises off east Northland lanternfish larvae were taken occasionally. Three species were distinguished.

Species 1

Two larvae, which probably belonged to 1 of the many species of *Diaphus*, were recorded off Cape Wiwiki in October 1977. The larger specimen (Fig. 14) was similar to, but less developed for its length than, 2 larvae from Spirits Bay that were figured by Regan (1916) and assigned to the genus *Diaphus*.

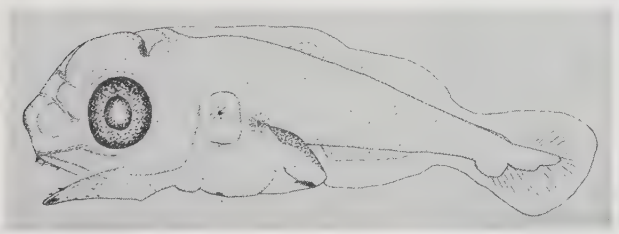


Fig. 14: Lanternfish larva, possibly *Diaphus* sp. (4.8 mm SL).

Species 2

Two specimens of an unrecorded species were taken at station 2, just north of Bream Head in December 1977. These larvae had greatly enlarged pectoral fins and fin bases (Fig. 15), as did the larvae of *Symbolophorus californiensis* described by Moser and Ahlstrom (1970), and they may belong to the same genus, which is represented locally by *S. barnardi* (D. A. Robertson pers. comm.).

Species 3

Two specimens were recorded, 1 off Whangaroa Harbour and the other off Cape Reinga. This species (Fig. 16) has a series of well-developed teeth, which extend to the front of the snout, and a strongly forked tail. From the fin ray counts (12 dorsal rays, 16 + anal rays) and general body form, it may be a species of *Lampanyctus*, or possibly a round-eyed species of *Hygophum*.

Family Moridae

Ahuru *Auchenoceros punctatus* (Hutton, 1873)

Eggs and larvae of ahuru, which were common in the early spring plankton of the inner Hauraki Gulf (Crossland 1981), were taken only occasionally during this study. When the outer Hauraki Gulf was sampled sea temperatures were above the range in which ahuru normally spawn.

Off east Northland a few eggs were taken at 3 stations near Whangaruru Harbour and in Doubtless Bay during October 1977. Larvae were also recorded at 3 stations; these were close to where the eggs were taken.

Unidentified morid

Larvae of an unidentified morid (Fig. 17) were much more common than those of ahuru. They had darker and more extensive pigmentation than ahuru larvae. They also lacked the single dorsal ray anterior to the dorsal fin that is characteristic of ahuru. Most were small (less than 5 mm SL), the lower specimen in Fig. 17 was the largest recorded (7.5 mm SL).

In the outer Hauraki Gulf these larvae were commoner during the December 1976 cruise (Fig. 18), when they were taken at many stations and over a wide area except close inshore. In February 1978 they were recorded at 6 stations which were far apart.

Off east Northland during October 1977 they were taken at 9 stations from the Bay of Islands to Cape Reinga and were most abundant in Rangaunu Bay. In December 1977 they were taken in smaller numbers at 4 stations.

There are 2 species of morid, besides ahuru, found in the study area: rock cod (*Lotella rhacinus* (Bloch and Schneider, 1801)) and red cod (*Pseudophycis bachus* (Bloch and Schneider, 1801)). Neither of these is particularly abundant, but both occur consistently and widely. It is unlikely that red cod spawn in northern New Zealand, because usually only immature specimens are found there. The larvae in Fig. 17 are therefore probably those of rock cod.

Family Exocoetidae

Flying fish *Cypselurus* sp.

A single larva (5.6 mm SL) (Fig. 19) was taken at station 7 off Bream Head on 1 February 1978.

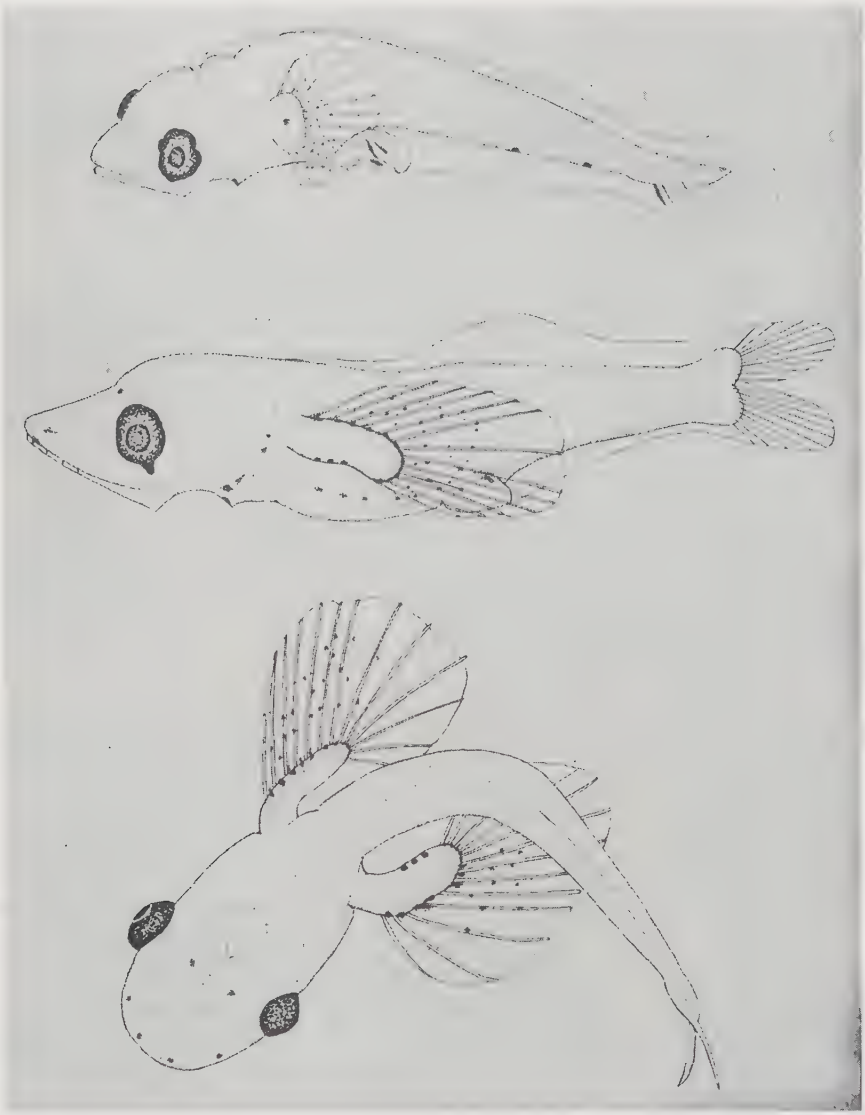


Fig. 15: Lanternfish larvae (5.2, 10.7 mm SL).

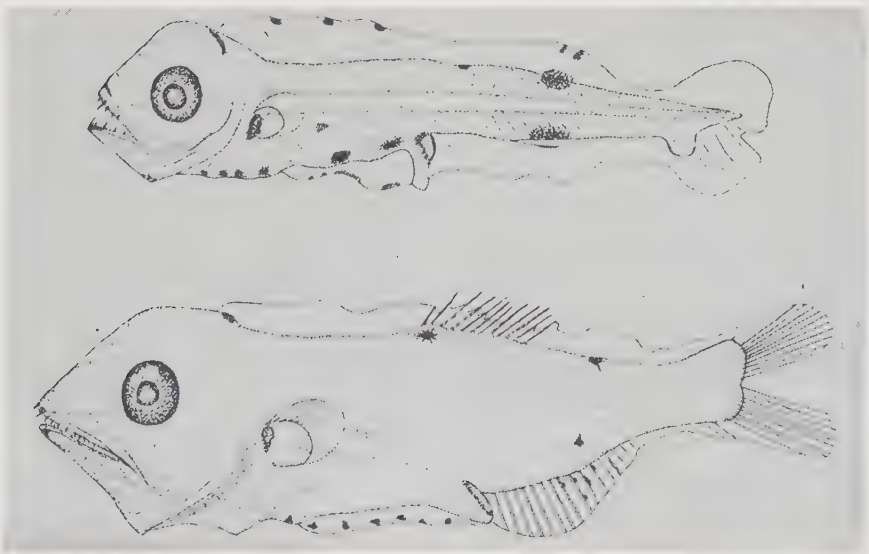


Fig. 16: Lanternfish larvae (7.4, 11.1 mm SL).

Fig. 17: Morid larvae (4.2 mm NL, 7.5 mm SL).

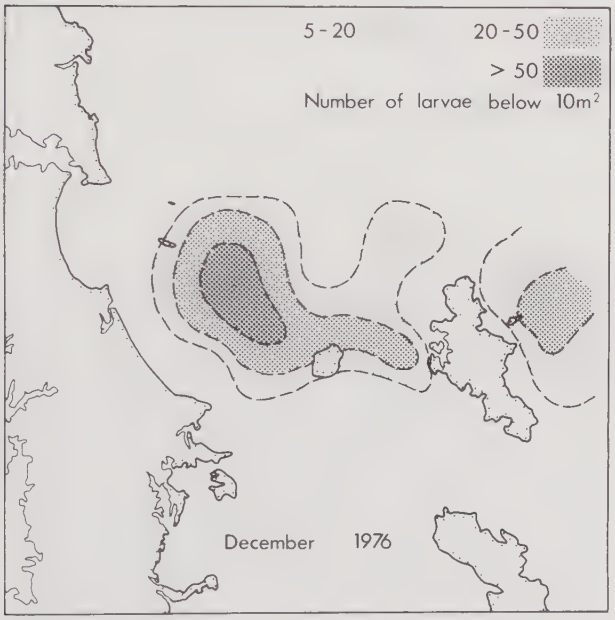


Fig. 18: Distribution of morid larvae (unidentified species) in the outer Hauraki Gulf.

Fig. 19: Flying fish (*Cypselurus* sp.) larva (5.6 mm SL).

Family Scomberesocidae

Saury *Scomberesox saurus* (Walbaum, 1792)

A single juvenile (54 mm SL) was taken at station 13 east of Great Barrier Island in the night sample on 4 February 1978.

Family Trachichthyidae

Roughy *Paratrachichthys trailli* (Hutton, 1876)

The egg of this species was described and figured by Robertson (1975).

Two eggs were taken at station 34 in Spirits Bay on 15 December 1977.

Roughy (unidentified species)

Crossland (1981) recorded an unknown egg (unidentified egg 2) which may have been that of a roughy. Eggs of this type were taken during all cruises in this study. In the outer Hauraki Gulf (Fig. 20) they were found around Great Barrier Island and the Hen and Chicken Islands. They were also taken on both east Northland cruises (Fig. 21), when they were found in small numbers consistently as far north as Henderson Bay.

Trachichthyid larvae, possibly of slender roughy (*Optivus elongatus* (Günther, 1859)), were taken by Crossland (1981) and during this study. They were commonest in the outer Hauraki Gulf during February 1978, when their distribution (Fig. 22) showed a close correlation with that of unidentified egg 2 (Fig. 20 right), except that the larvae were south of the eggs found around the Hen and Chicken Islands. This may have been due to the south-setting East Auckland Current.

It is difficult to sample adult slender roughy because they inhabit rocky areas where trawling is not usually possible, and they are too small to catch by hook. However, in 1973 many slender roughy were caught with a fine mesh liner in a trawl shot close inshore on the south side of the Hen and Chicken Islands and coincident with the centre of egg distribution in Fig. 20 (right). The evidence, therefore, suggests these eggs and larvae are those of *O. elongatus*.

Family Zeidae

John Dory *Zeus faber* Linnaeus, 1758

Eggs of John Dory were described by Robertson (1975). However, there are no published accounts of the occurrence of eggs or larvae in the plankton.

In the outer Hauraki Gulf a few eggs were taken at 2 stations in December 1976 and 6 stations in February 1978. They were recorded mostly at the outer stations. A few larvae were taken near Bream Head at stations 7 and 8 in February 1978. These larvae (Fig. 23) were easily recognised because of their likeness to the adults.

Family Syngnathidae

Small juvenile seahorse (*Hippocampus abdominalis* Lesson, 1818) were taken at 1 station on both east

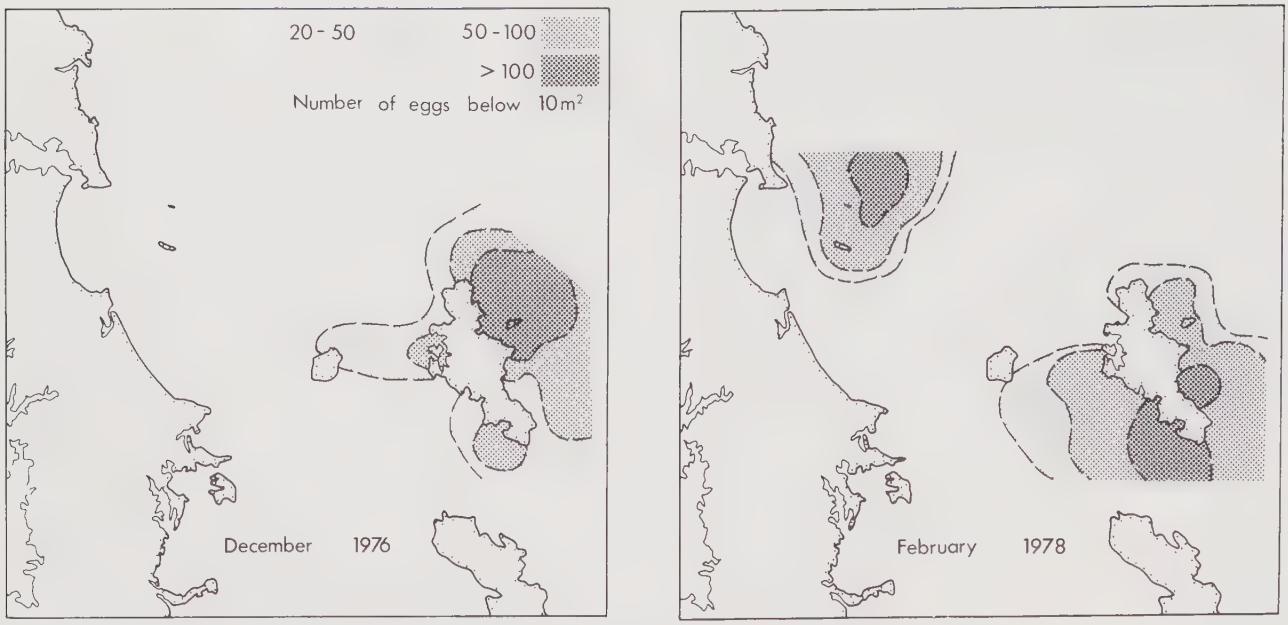


Fig. 20: Distribution of unidentified egg 2 in the outer Hauraki Gulf.

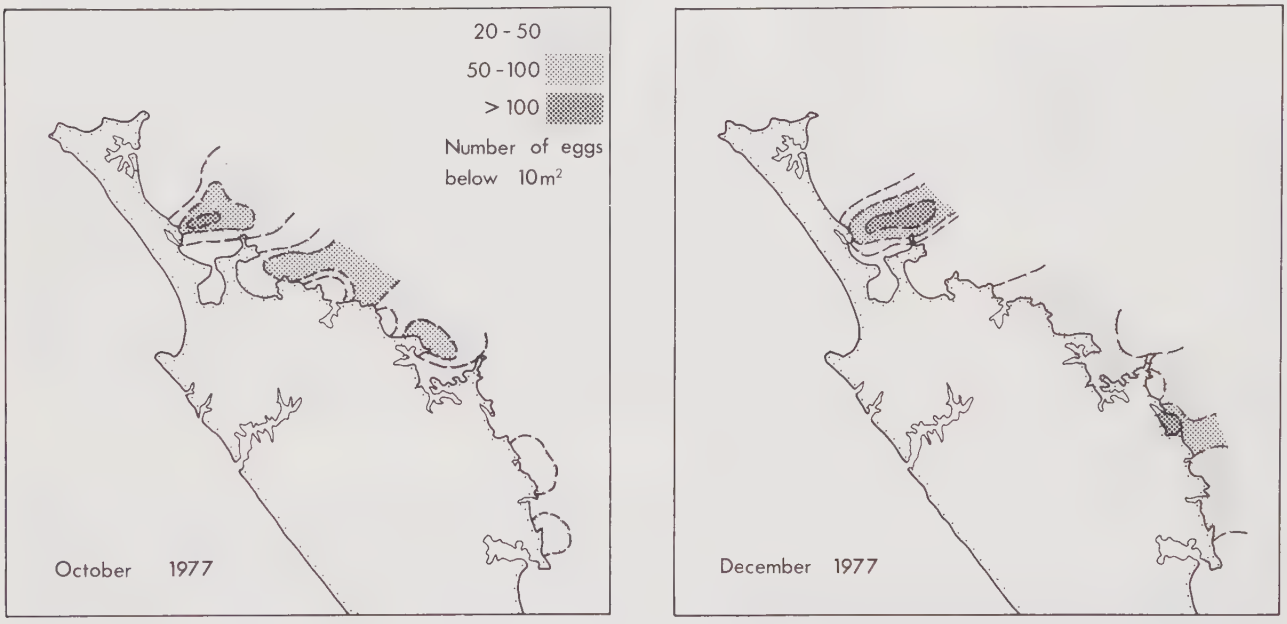


Fig. 21: Distribution of unidentified egg 2 off east Northland.

Northland cruises, and a single juvenile short-snouted pipefish (*Lissocampus filum* (Günther, 1870)) was taken in December 1977.

Family Scorpaenidae

Unidentified scorpaenid

Scorpaenid larvae (Fig. 24) were taken at 3 stations off east Northland in October 1977. All were small and caudal flexion had not occurred.

At least 10 scorpaenids occur in northern New Zealand (C. D. Paulin pers. comm.), but only 2 are common: red scorpionfish (*Scorpaena cardinalis* Richardson, 1842), and sea perch (*Helicolenus percoides* (Richardson, 1842)). Graham (1956) observed the spawning of sea perch (which releases a gelatinous egg balloon) and described and illustrated the early life stages. He recorded (page 348) that after yolk absorption the larva had "black pigmented stellate markings, one above the vent and the other midway

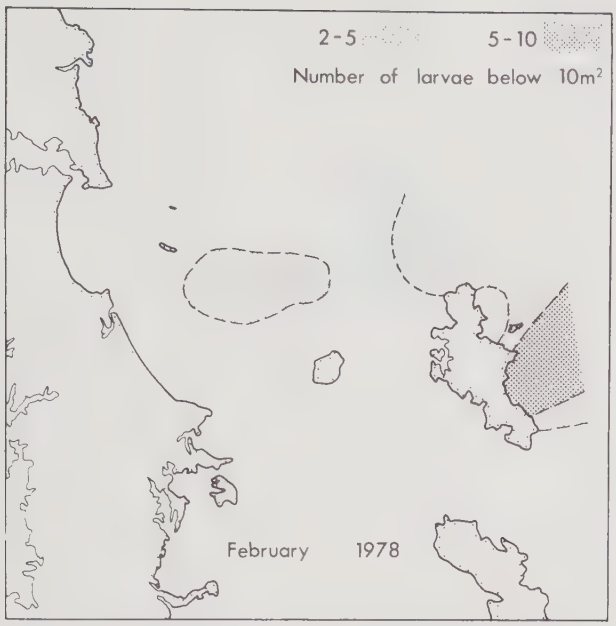


Fig. 22: Distribution of roughy larvae (unidentified species) in the outer Hauraki Gulf.

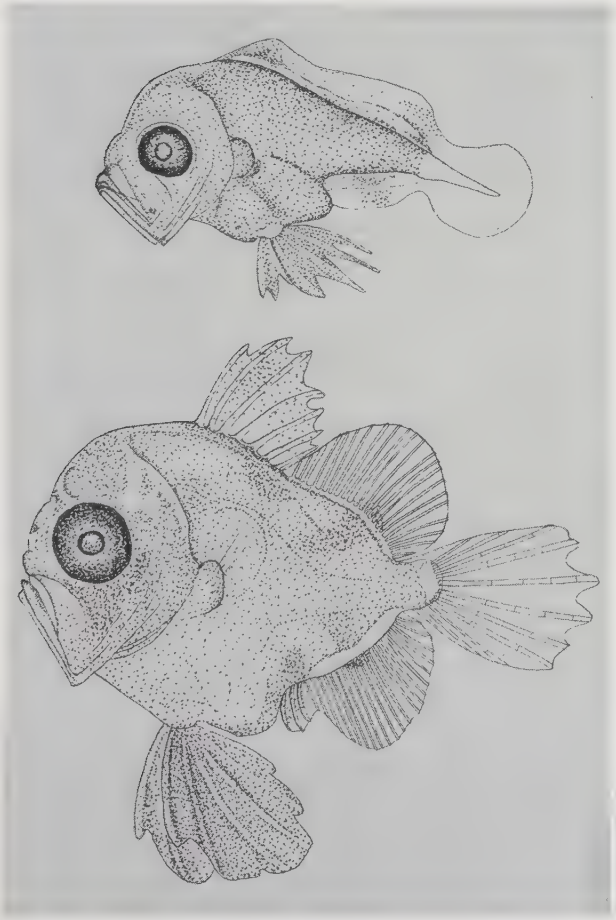


Fig. 23: John Dory (*Zeus faber*) larvae (4.3 mm NL, 7.2 mm SL).

Fig. 24: Scorpaenid larva (3.6 mm NL).

towards the tail on the lower margin." Similar post-anal pigmentation occurs in *H. dactylopterus* (Tåning 1961), whereas larvae of *Scorpaena* spp. have "a row of melanophores along the ventral midline of the tail" (Moser, Ahlstrom, and Sandknop 1977, page 54). This information suggests that these larvae are more likely to be those of sea perch than red scorpionfish, though the latter is probably more common in the study area.

Family Triglidae

Red gurnard *Chelidonichthys kumu* (Lesson and Garnot, 1826)

The red gurnard egg was described and figured by Robertson (1975) and Mito (1963), who also illustrated the early stage larva. Previous records of eggs and larvae in the plankton are by Robertson (1980a) and Crossland (1981).

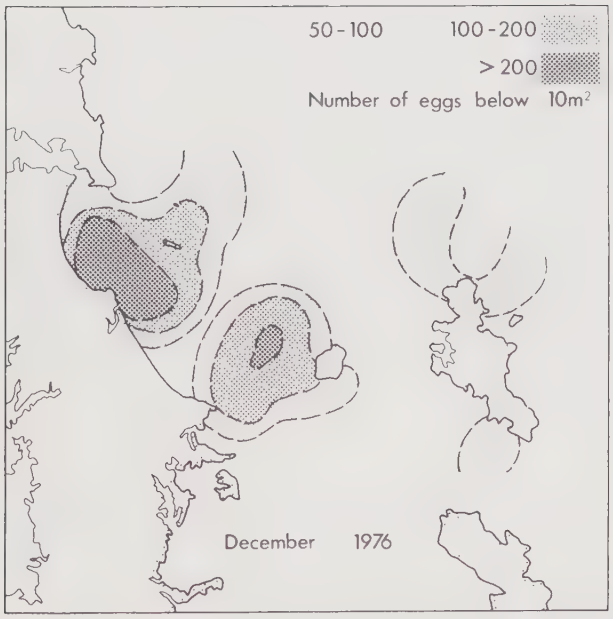
Outer Hauraki Gulf. Eggs were taken during both sampling periods. They were never abundant, and were mainly in the western half of the study area (Fig. 25) between Bream Head and Little Barrier Island.

Larvae were more common on the first cruise (Fig. 26) and their distribution closely matched that of the eggs.

East Northland. A few eggs were taken on both cruises, with about 3 times as many being recorded in October 1977 as in December 1977. The main concentrations were in the Bay of Islands and Great Exhibition Bay (Fig. 27).

Larvae were recorded in the same area; at 7 stations during October 1977 and at 1 station in December 1977.

These results, and those of Crossland (1981), show that red gurnard have a long spawning period off north-east New Zealand. It extends at least from October to February, with perhaps the heaviest spawning being in October-November (see also Elder 1976). Robertson (1980a) also found a spring-summer



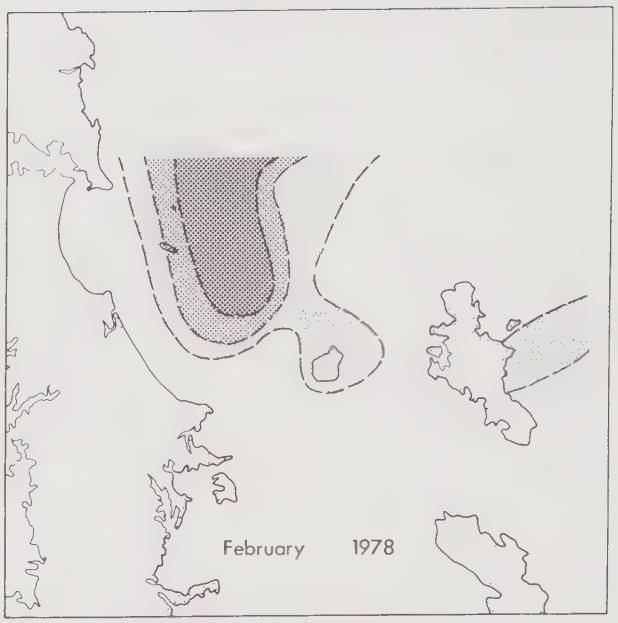


Fig. 25: Distribution of red gurnard eggs in the outer Hauraki Gulf.

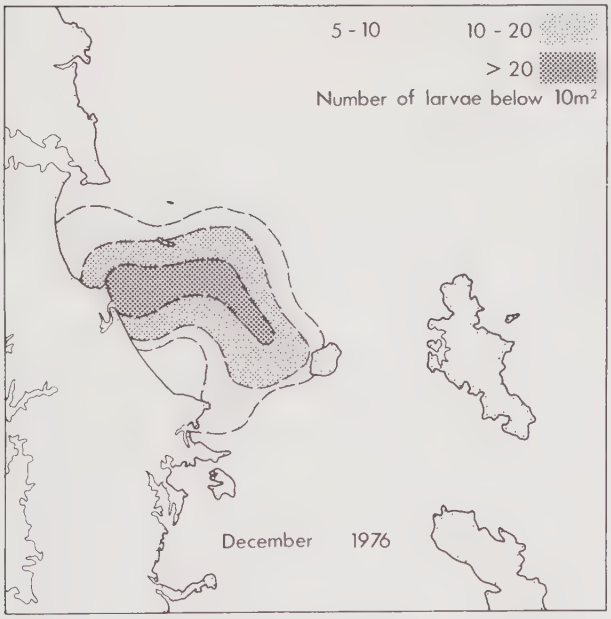


Fig. 26: Distribution of red gurnard larvae in the outer Hauraki Gulf.

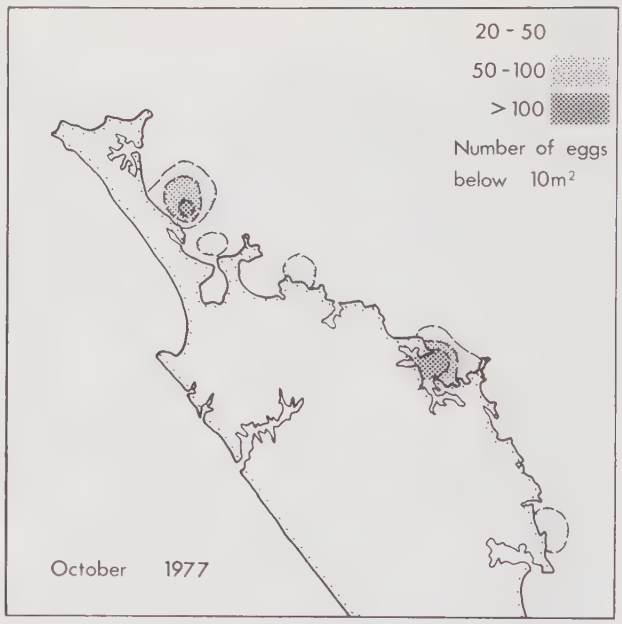


Fig. 27: Distribution of red gurnard eggs off east Northland.

spawning season in Otago waters. His results showed that red gurnard were mid-shelf spawners. During this study the observed spawning centre in the Bay of Islands in October 1977 showed that red gurnard also spawn in shallow inshore areas.

Family Acanthoclinidae

Rockfish *Acanthoclinus quadridactylus* (Bloch and Schneider, 1801)

Larvae of *A. quadridactylus* and *A. trilineatus* (Griffin, 1933), small littoral fish which lay demersal eggs, were recorded by Crossland (1981). However, during this study only larvae of *A. quadridactylus* were recognised. Small larvae of *A. quadridactylus* up to 5.5 mm long were figured by Jillett (1968); a larger specimen is shown in Fig. 28. These larvae can be distinguished from those of *A. trilineatus* by their stouter body and greater dorsal and anal fin ray counts (Griffin 1933).

Rockfish larvae were not common in the outer Hauraki Gulf, where only a few were taken at 3 stations on each cruise. However, the sampling periods were outside the main spawning season (winter and spring) (Jillett 1968, Crossland 1981). Off east Northland rockfish larvae were much more abundant (Fig. 29) and were found at many stations. They were common off Cape Karikari on both cruises. In December 1977, 178 larvae were taken at station 23; this was the most I have recorded of this species in a single haul.

Family Carangidae

Jack mackerel *Trachurus novaezelandiae* (Richardson, 1843)

Crossland (1981) recorded the spawning of this species and gave descriptions and figures of eggs and larvae.

Outer Hauraki Gulf. Eggs of this spring-summer spawner were the most abundant kind taken on both cruises. At many stations over 1000 eggs were recorded and at station 7 off Bream Head in December 1976 almost 10 000 were taken. The eggs were widely distributed, with a dense concentration near the Hen and Chicken Islands in December 1976 (Fig. 30). In February 1978 heaviest spawning occurred north-west of Little Barrier Island and east of Great Barrier Island.

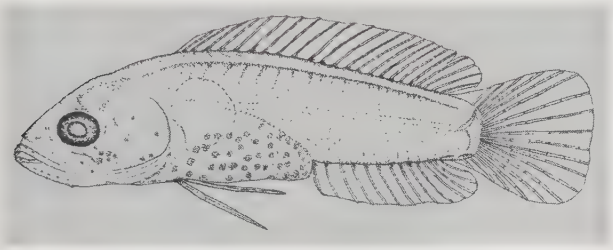


Fig. 28: Rockfish *Acanthoclinus quadridactylus* larva (9.9 mm SL).

Larvae were also very abundant; in December 1976 their numbers were exceeded only by those of anchovy and pilchard. They were distributed mainly over the western half of the study area (Fig. 31), with the largest numbers being taken between the Hen and Chicken Islands and Little Barrier Island. This distribution was similar to that of the eggs, but was displaced a few nautical miles to the south. Larvae were again abundant in February 1978 and had a similar distribution.

East Northland. Fewer eggs were taken here than in the outer Hauraki Gulf, but they were still an important component of the ichthyoplankton, and during December 1977 they were the most abundant type. In October 1977 spawning was mainly in the southern half of the study area, with centres in the outer Bay of Islands and off Bream Head (Fig. 32). In December 1977 spawning was again centred in these areas, with an additional centre in Great Exhibition Bay.

Larvae were not common on either cruise and occurred only in scattered places (Rangaunu Bay, Bay of Islands, and Bream Head), usually close to the egg concentrations (Fig. 33).

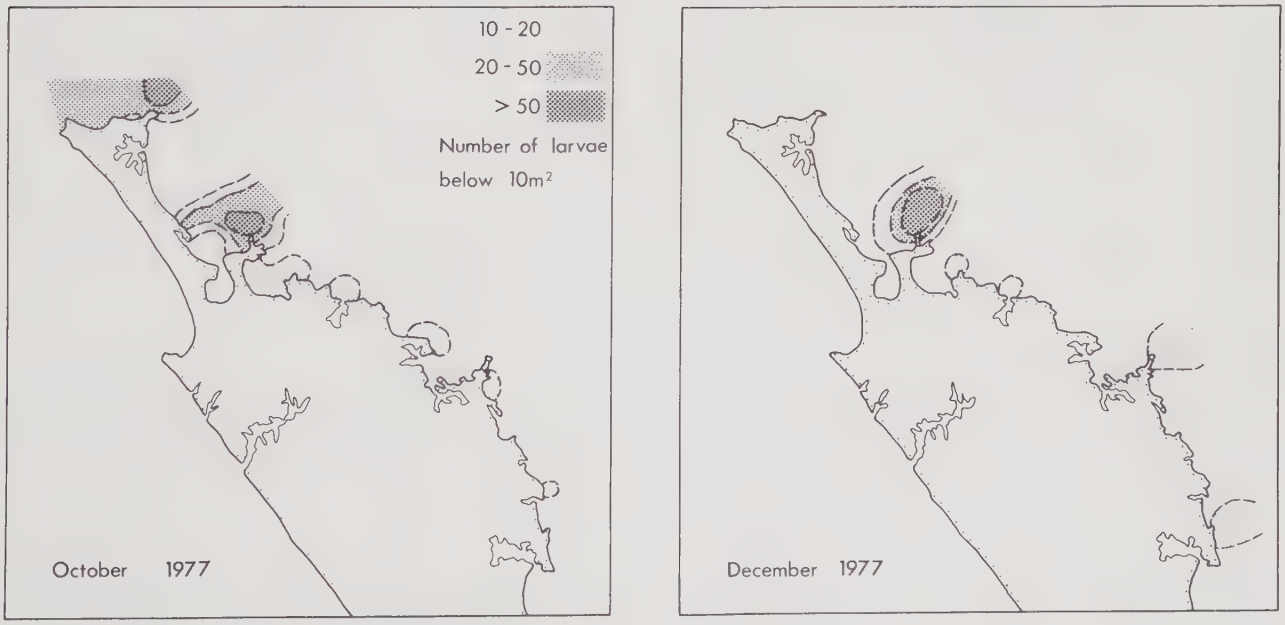


Fig. 29: Distribution of rockfish larvae off east Northland.

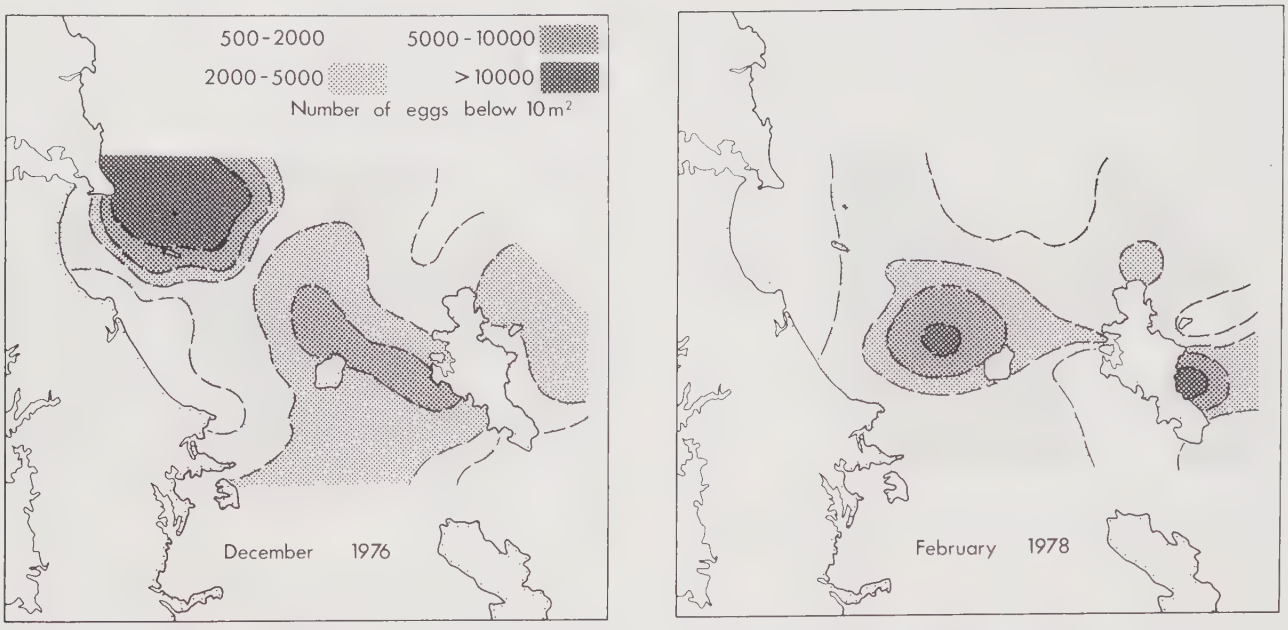


Fig. 30: Distribution of jack mackerel *Trachurus novaezelandiae* eggs in the outer Hauraki Gulf.

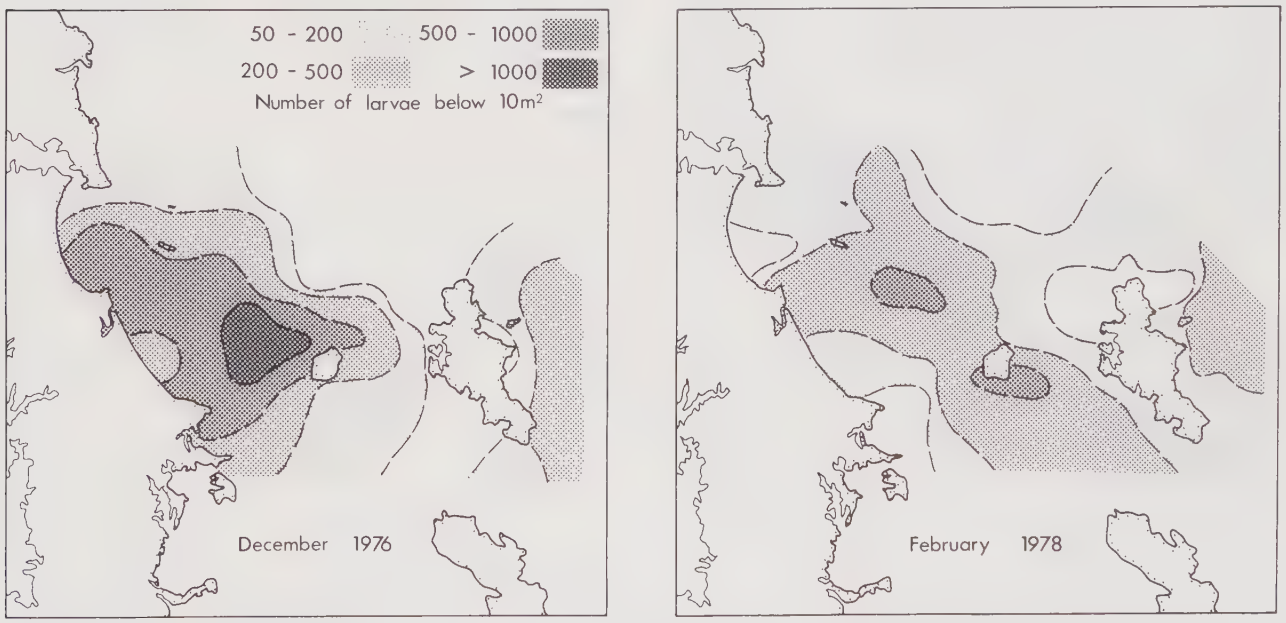


Fig. 31: Distribution of jack mackerel *T. novaezelandiae* larvae in the outer Hauraki Gulf.

Sea temperatures during the east Northland cruises were below the preferred spawning temperature range for this species (16.5–18.5 °C) found by Crossland (1981).

Jack mackerel *Trachurus declivis* (Jenyns, 1841)

Eggs of *T. declivis* were described by Crossland (1981) and were recorded occasionally in the inner Hauraki Gulf.

During this study a few were taken at 8 stations in the outer Hauraki Gulf in December 1976 and at 14 stations in February 1978. Off east Northland they were found at 6 stations on each cruise; usually only 1 or 2 eggs being taken.

Trevally *Caranx georgianus* Cuvier, 1833

Trevally eggs and larvae were described and figured by James (1976).

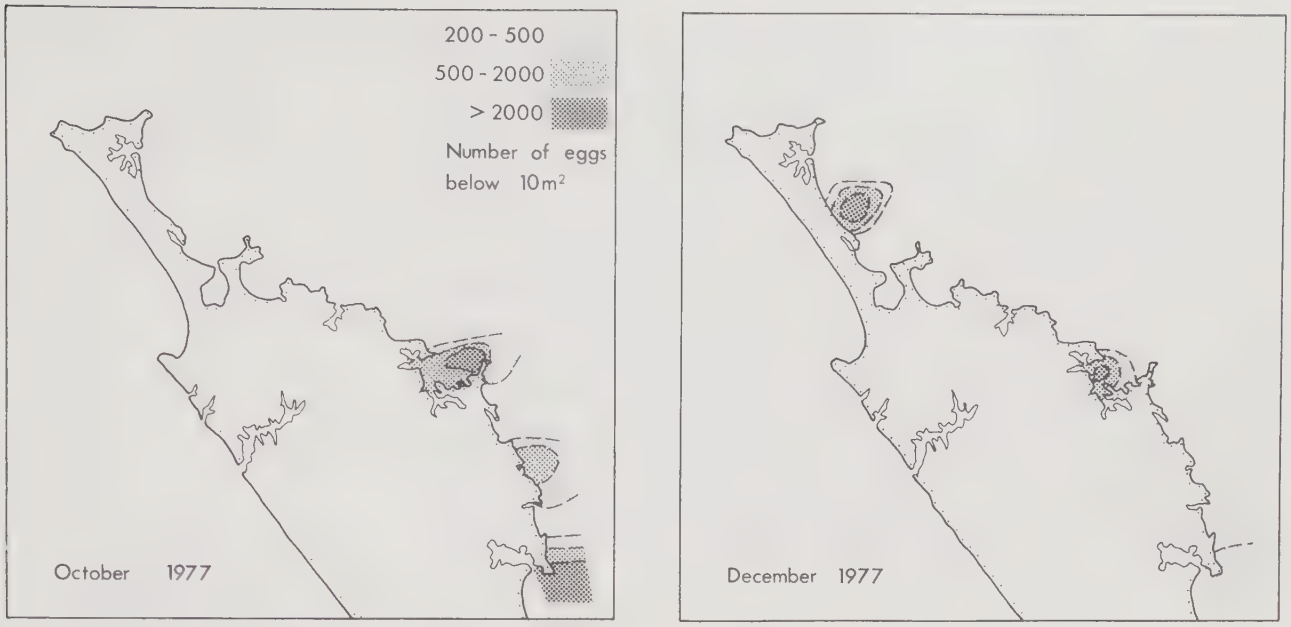


Fig. 32: Distribution of jack mackerel *T. novaezelandiae* eggs off east Northland.

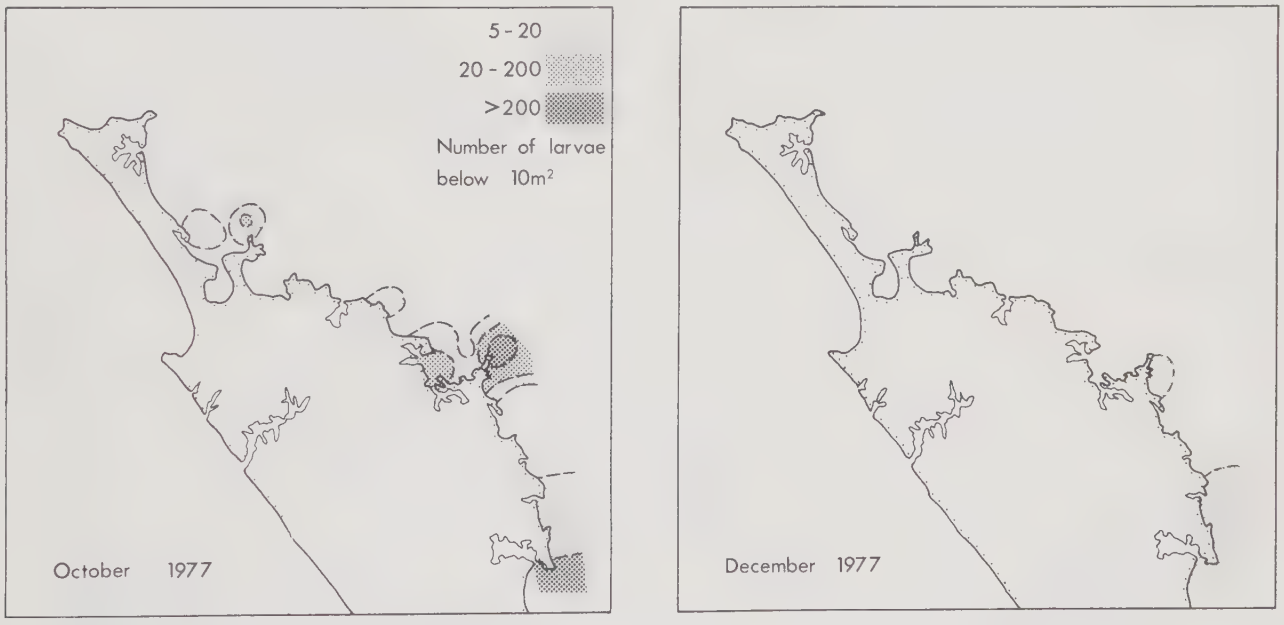


Fig. 33: Distribution of jack mackerel *T. novaezelandiae* larvae off east Northland.

Eggs of this species were not positively identified during this study, but it was thought that those recorded as unidentified egg 1 (see page 45) may have been trevally eggs. A few larvae were taken at 5 stations in the outer Hauraki Gulf during February 1978.

Unidentified carangid

Many previously unrecorded carangid larvae, 5–9 mm long (Fig. 34), were taken off Northland during October 1977. They were similar to larvae of *T. novaezelandiae*, but more darkly pigmented. In that respect they resembled larvae of trevally, but were not likely to be of that species, as it is a summer spawner. In addition, larger specimens had 2 small crests on top of the head (Fig. 34), whereas trevally larvae have a single, slightly larger crest. *Trachurus novaezelandiae* larvae do not have this feature.

These larvae were recorded from Cape Reinga to Doubtless Bay (Fig. 35), with a centre of abundance off Great Exhibition Bay. They were more common offshore than inshore.

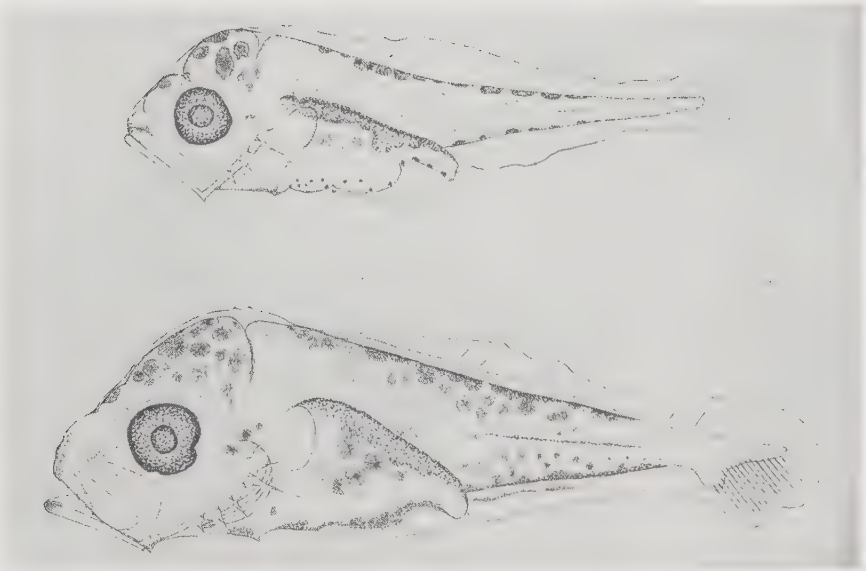


Fig. 34: Carangid larvae (5.2 mm NL, 6.8 mm SL).

There are 3 common carangids in northern New Zealand of which the larvae are not known; jack mackerel *T. declivis*, koheru (*Decapterus koheru* (Hector, 1875)), and kingfish *Seriola lalandi* Cuvier and Valenciennes, 1833. The unidentified larvae were more likely to have been those of *T. declivis* than of the other species for the following reasons: they were similar to *T. novaezelandiae* larvae; larvae of *Seriola quinqueradiata* (probably synonymous with *S. lalandi*) are known (Uchida, Dôtu, Mito, and Nakahara 1958) and have a much narrower body; and *T. declivis* lives further offshore in deeper water than the others, which is consistent with the distribution of these larvae.

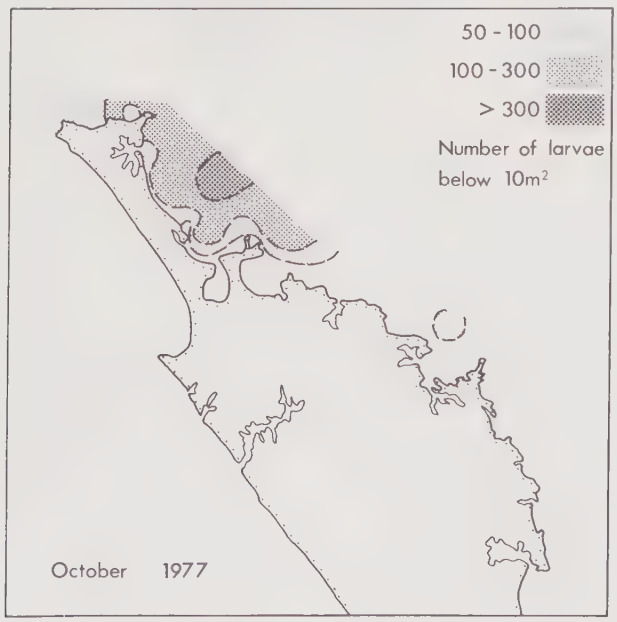


Fig. 35: Distribution of carangid larvae (unidentified species) off east Northland.

Family Arripidae

Kahawai *Arripis trutta* (Bloch and Schneider, 1801)

The kahawai egg was described by Robertson (1975). It has a diameter of 0.90–0.98 mm; a non-segmented yolk; and a single oil droplet of 0.24–0.28 mm diameter. This description is similar to that by Cassie (1956b) of the snapper egg (which has a diameter of 0.862–0.966 mm; a non-segmented yolk; and an oil droplet of 0.25 mm diameter).

Two hundred and forty early stage eggs resembling snapper eggs, but with a slightly larger oil droplet, were taken at station 28 in the outer Hauraki Gulf in February 1978 and were identified as kahawai eggs. They ranged in size from 0.88 to 0.98 mm diameter, with a mean of 0.94 mm; had an average perivitelline space of 0.06 mm; and had an oil droplet of 0.25–0.31 mm diameter, with a mean of 0.27 mm. The oil droplet was dense and dark yellow with melanophores on its surface. These were probably eggs of kahawai, because many were taken from a single spawning at only 1 station in February 1978, and this is consistent with the schooling habits of this summer-spawning species.

Family Sparidae

Snapper *Chrysophrys auratus* (Forster, 1801)

The snapper egg was described and figured by Cassie (1956b) and Crossland (1980) and the larvae by Crossland (1981). Records of the spawning of snapper based on plankton surveys are given by Cassie (1956a) and Crossland (1980, 1981).

Outer Hauraki Gulf. Snapper eggs were abundant in December 1976, when they were the second most common egg type. Spawning was widespread (Fig. 36) with centres near Bream Head and in Cradock Channel. In addition, many eggs were recorded at stations 1 and 2 (in the inner gulf), but these concentrations, and that off Bream Head, were not as great as peak spawning densities observed before in the inner gulf. In February 1978 eggs were much less abundant and were taken mainly in the south, most being recorded off Blind Bay (see Table 5).

Larvae were common on both cruises. In December 1976 they were most abundant off Cape Rodney, and many were taken near Bream Tail and east of Great Barrier Island (Fig. 37). Their distribution was similar in February 1978, but the largest catches were taken off Great Barrier Island. Generally the larval distribution was south of that of the eggs taken on the corresponding cruise, but on neither cruise were many eggs found near the larval concentration east of Great Barrier Island.

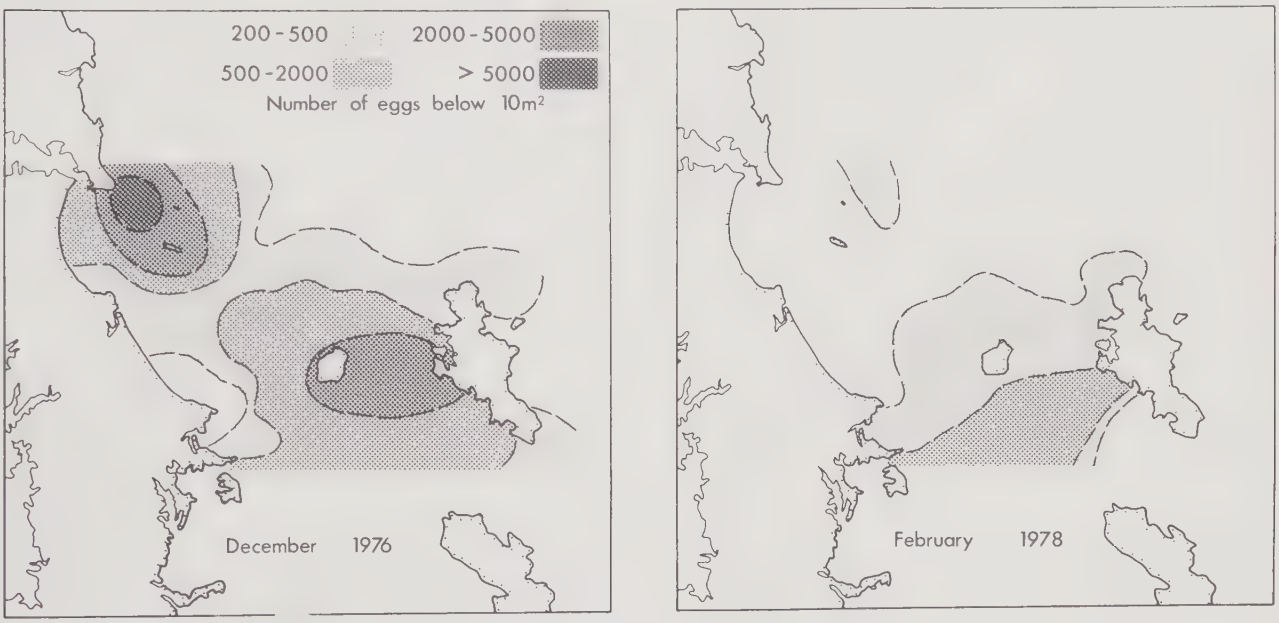


Fig. 36: Distribution of snapper eggs in the outer Hauraki Gulf.

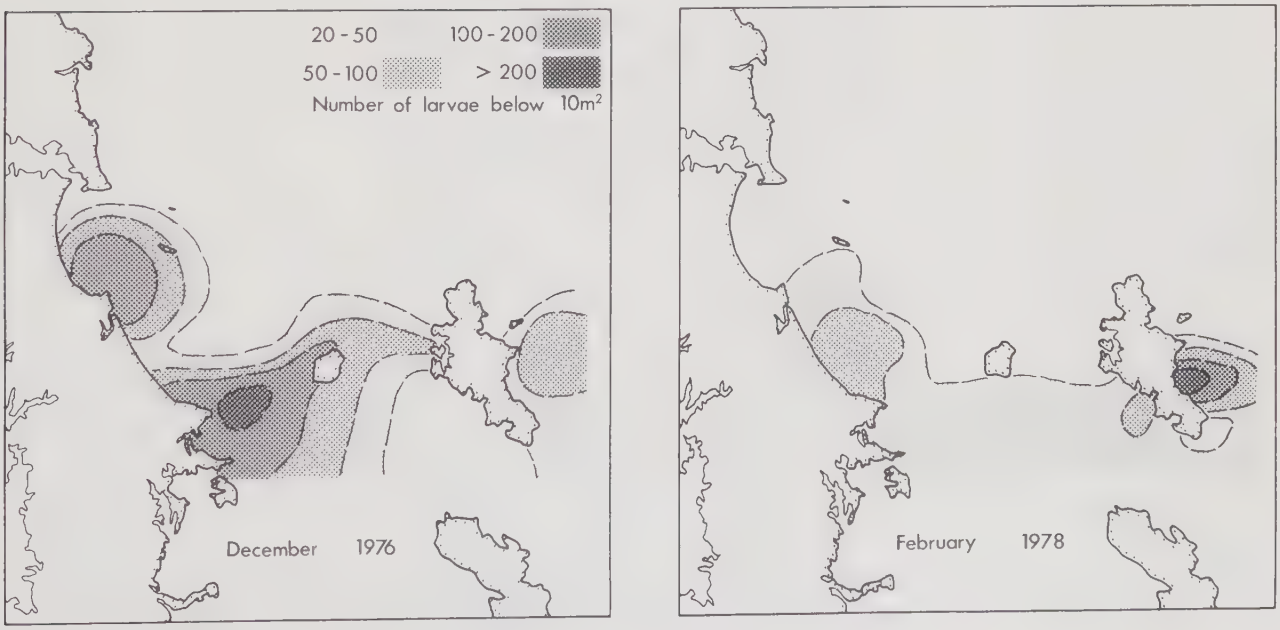


Fig. 37: Distribution of snapper larvae in the outer Hauraki Gulf.

East Northland. Eggs were not abundant on either cruise, except for a concentration in the Bay of Islands (Fig. 38) during October 1977. In December 1977 very few were taken.

Many larvae were found in the Bay of Islands in October 1977 (Fig. 39). Their distribution was centred further out in the bay than the eggs and extended south to Cape Brett. In December 1977 larvae were again taken in the Bay of Islands, but in smaller numbers, which corresponded to the relative abundance of eggs on the 2 cruises.

Snapper are abundant along the whole of the east Northland coast and the absence of significant spawning was probably because of the unseasonably low temperatures. Sea bottom temperatures were almost always below the preferred spawning range of snapper (15–17 °C) (Crossland 1981). The sea bottom temperatures in December 1977 were generally lower than those in October 1977 and this probably resulted in a smaller number of eggs being taken compared with what would be expected under normal spawning conditions.

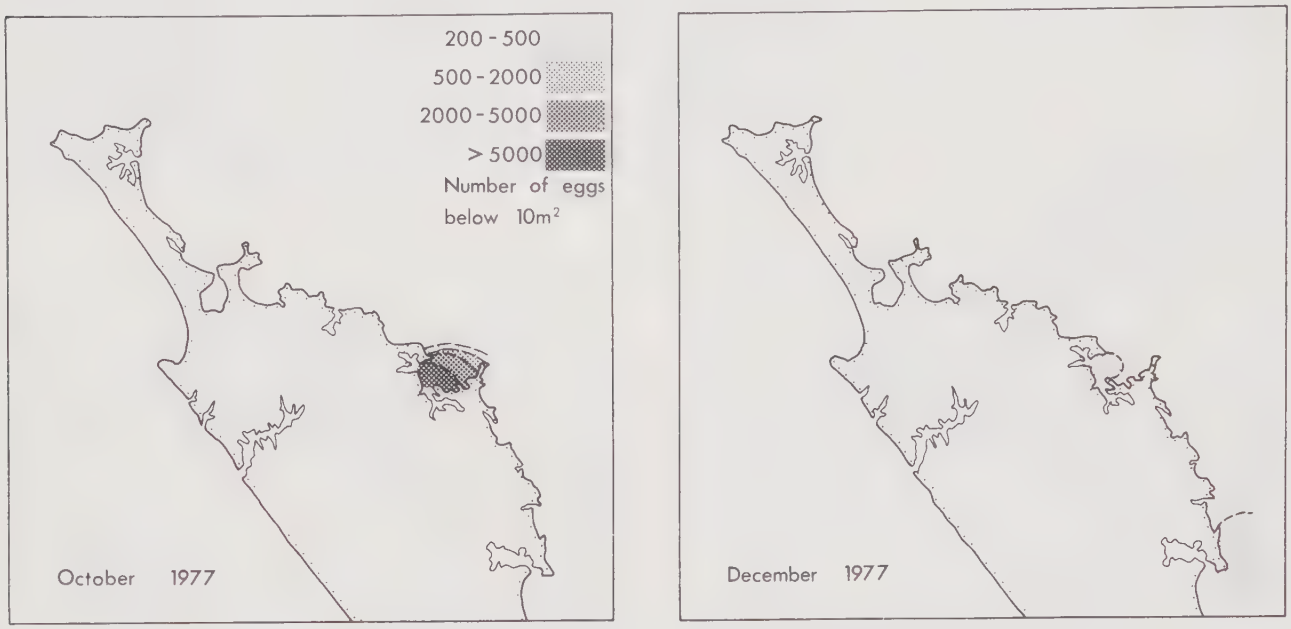


Fig. 38: Distribution of snapper eggs off east Northland.

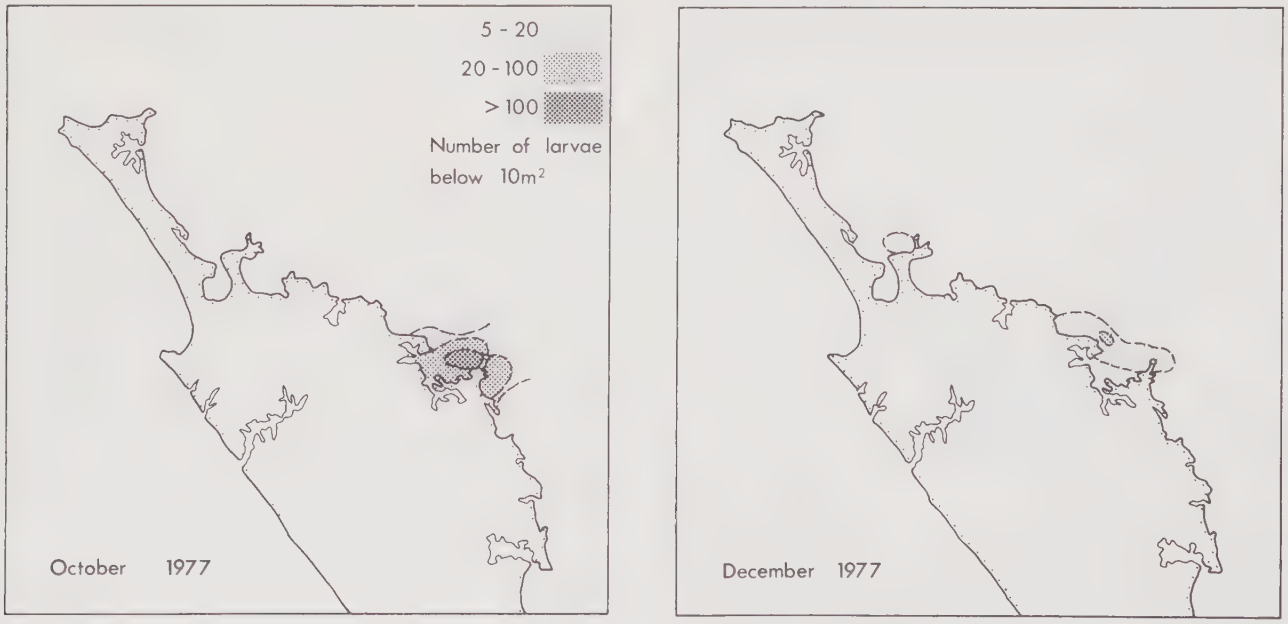


Fig. 39: Distribution of snapper larvae off east Northland.

Family Cepolidae

Bandfish *Cepola aotea* Waite, 1910

Eggs and larvae of this species have not been described. It is not known if the eggs are planktonic.

A few larvae were taken during February 1978 in the outer Hauraki Gulf. These were identified as being those of *C. aotea* because of their close resemblance to the larvae of *C. rubescens*, which were described and figured by Russell (1976). Characteristic features of small bandfish larvae are the occipital and preopercular spines (Fig. 40 top). There are also spines on the lower jaw. Larger larvae (Fig. 40 bottom) show the continuous, many-rayed dorsal, caudal, and anal fins, as in the adults. However, the head and body depth is proportionally much greater in the larvae than in the attenuated adults.

The distribution of bandfish larvae was centred between the Hen and Chicken Islands and the Mokohinau Islands (Fig. 41) where bottom depths were 75–125 m. The larvae ranged from 3.6 mm NL to 13.0 mm SL.

Family Mugilidae

Yellow-eyed mullet *Aldrichetta forsteri* (Valenciennes, 1836)

The yellow-eyed mullet egg was described by Cassie (1956b) and figured by Crossland (1981).

A few eggs were taken at 4 stations in the outer Hauraki Gulf in December 1976. Larvae were taken at 2 stations on that cruise and 3 stations in February 1978. Off east Northland only a few eggs were recorded. They were taken at 11 and 2 stations respectively on the October and December 1977 cruises.

Family Labridae

There are at least 14 species of this family in New Zealand (Doak 1972), most of which are found in the study area, where they are common components of the reef fauna. The eggs of spotty (*Pseudolabrus celidotus* (Forster, 1801)) and banded parrotfish (*P. fucicola* (Richardson, 1840)) are known (Robertson 1975), and the larva of spotty was figured by Crossland (1981). The distribution and abundance of the eggs of both species in Otago waters were described by Robertson (1980a), and the occurrence of spotty larvae in the Hauraki Gulf was described by Crossland (1981).

Because of the similarity of the eggs of spotty (which have a diameter of 0.725–0.800 mm; a non-segmented yolk; and a single oil droplet of 0.150 mm diameter) to those of banded parrotfish (which have a diameter of 0.775–0.875 mm; a non-segmented yolk; and an oil droplet of 0.175 mm diameter) and the possibility that other species of this family may have similar eggs, it was difficult to identify eggs of this type to species level. During this study eggs in the size range 0.73–0.83 mm diameter, with a non-segmented yolk and a single oil droplet of 0.15–0.18 mm diameter, were tentatively assigned to the family Labridae. It is likely that more than 1 species is found in the area, and it is possible that an unrelated species may have similar eggs.

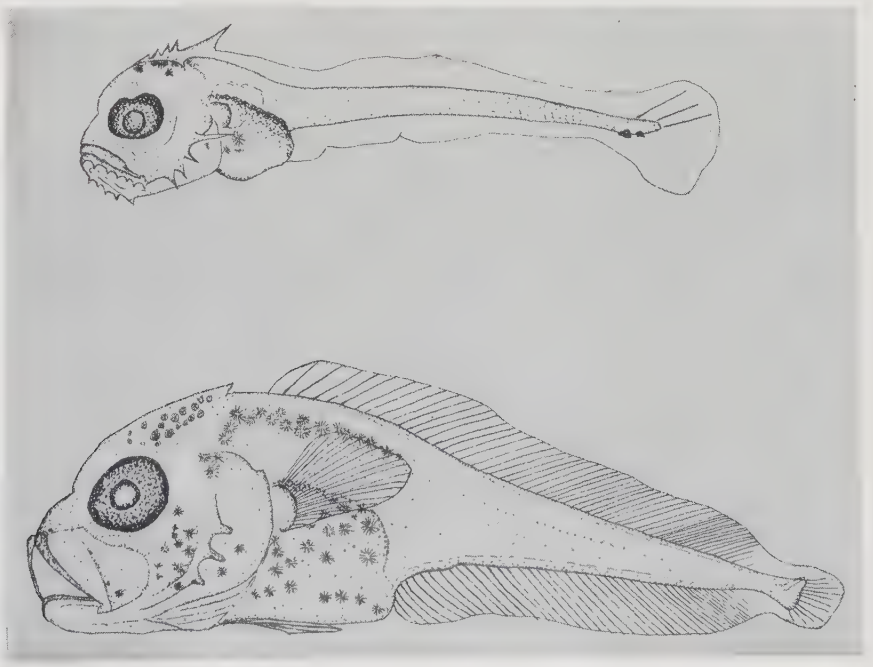


Fig. 40: Bandfish (*Cepola aotea*) larvae (4.0 mm NL, 13.0 mm SL).

Labrid larvae were also difficult to identify. Although they could be confidently placed in this family, most larvae were small (less than 10 mm SL) and further identification was not possible. The most common species is shown in Fig. 42.

Outer Hauraki Gulf. A few labrid eggs and larvae were taken at several stations on both cruises.

East Northland. In October 1977 eggs were quite common and were taken at 18 stations. They were usually found near areas of rocky coastline and were not taken at any offshore stations. In December 1977 they were found at only 1 station.

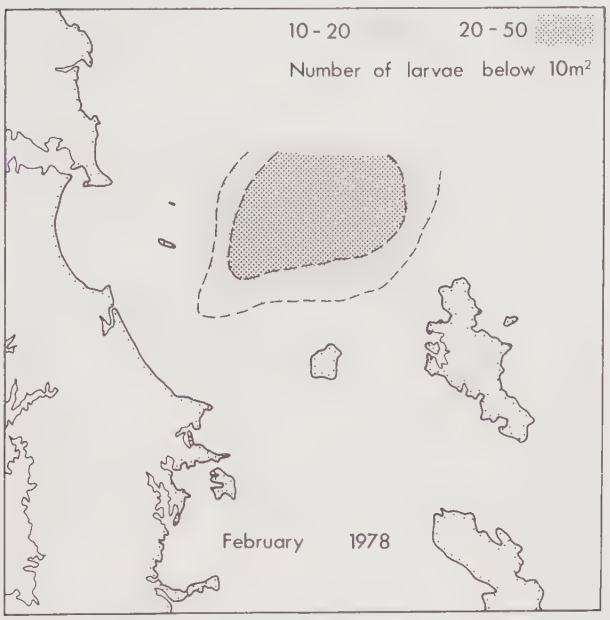


Fig. 41: Distribution of bandfish larvae in the outer Hauraki Gulf.

Larvae were much more common than eggs. In October 1977 they were recorded at 28 stations and were most abundant between the Bay of Islands and Doubtless Bay. In December 1977 they were again recorded regularly, though fewer were taken, except at station 12 in the Bay of Islands, where the maximum number of larvae in a single haul was recorded.

The greater numbers of larvae may have been due to the fact that the main spawning period occurred before sampling (Doak (1972) recorded labrids as being winter spawners), or spawning may have taken place very close to shore where the eggs would not have been adequately sampled. It is also possible that some labrids may have demersal eggs, as is known from Great Britain (Russell 1976).

Family Odacidae

Butterfish *Coridodax pullus* (Forster, 1801)

The egg of this species was described and figured by Robertson (1975). Butterfish are more common in the south of New Zealand, and they live among seaweed-covered rocks.

A few butterfish eggs were taken at 4 widely scattered stations off east Northland during October 1977, but at only 1 station in December 1977.

Family Percophididae

Opal fish *Hemerocoetes* sp.

The genus *Hemerocoetes* was revised by Nelson (1979), who recorded 5 species, of which 3 occur off north-east New Zealand. The adults are not often sampled, because of their small size and habit of burying themselves in the sand. However, they may

Fig. 42: Labrid larvae (4.6 mm NL, 7.2 mm SL).

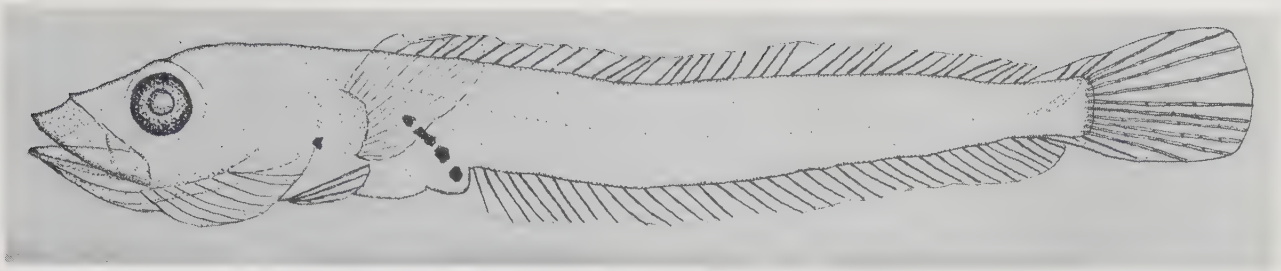


Fig. 43: Opal fish (*Hemerocoetes* sp.) larva (16.0 mm SL).

be quite common. Eggs were not identified during this study (it is not known if they are planktonic), but larvae were recognised by building up a developmental series. Opal fish larvae are long and slender. The specimen in Fig. 43 was the largest taken. It may be either *H. monopterygius* (Schneider, 1801) or *H. macrophthalmus* Regan, 1914, both of which have similar fin ray counts.

Hemerocoetes larvae are superficially similar to those of the 2 creediid species described below. However, they can be distinguished from them by several features; for example, the dorsal fin origin is well anterior to that of the anal fin, the pre-anal distance is shorter, the eye is proportionally larger and nearer the top of the head, and the pectoral fins are much larger.

A few opal fish larvae were taken at 1 station in the outer Hauraki Gulf in December 1976 and at 6 stations in February 1978. Off east Northland a few were recorded at 4 stations in October 1977, but they were more common in December 1977, when they were taken at 11 stations, with the main centre of abundance being between Cape Karikari and Great Exhibition Bay (Fig. 44).

Family Creediidae

Nelson (1978) gave a key to this family, within which he included the Limnichthyidae. There are no published records of the early life history of the 3 New Zealand creediid species, and it is not known if their eggs are demersal or planktonic. However, creediid larvae were taken on both east Northland cruises. A larval series was built up and the larvae were identified as belonging to 2 species: tommyfish (*Limnichthys rendahli* Parrott, 1958) and sand diver (*Tewara cranwellae* Griffin, 1933).

Tommyfish *Limnichthys rendahli*

The tommyfish larva (Fig. 45) is long and moderately slender, with a standard length to maximum depth ratio of 6:1. The origins of the dorsal and anal fins are almost directly in line. In the other New Zealand species of *Limnichthys* (*L. polyactis* Nelson, 1978) the origin of the anal fin is anterior to that of the dorsal fin. The pattern of brown melanophores on the lower half of the post-anal region immediately distinguishes this species from *T. cranwellae*.

In October 1977 tommyfish larvae were taken at 14 stations, mainly in the northern half of the study area. The largest numbers were recorded off Cape Karikari, in Rangaunu Bay, and off Cape Reinga (Fig. 46 left). In December 1977 they were much less abundant and were taken at only 5 stations. This indicates a winter-early spring spawning period.

Sand diver *Tewara cranwellae*

Sand diver larvae (Fig. 47) are long and slender, with a standard length to maximum depth ratio of 7.6:1, and they have little pigmentation. The origin of the anal fin is slightly anterior to that of the dorsal fin. Although this characteristic is the same in *L. polyactis* larvae, the 2 species can be separated, as *T. cranwellae* have more fin rays (Nelson 1978). The figured specimen (16.7 mm SL) had 33 dorsal rays and 35 anal rays. Two other specimens, both 16.0 mm SL,

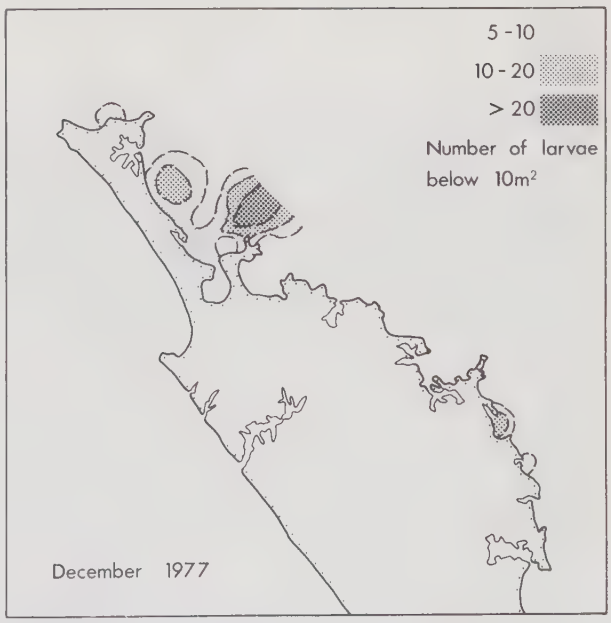


Fig. 44: Distribution of opal fish larvae off east Northland.

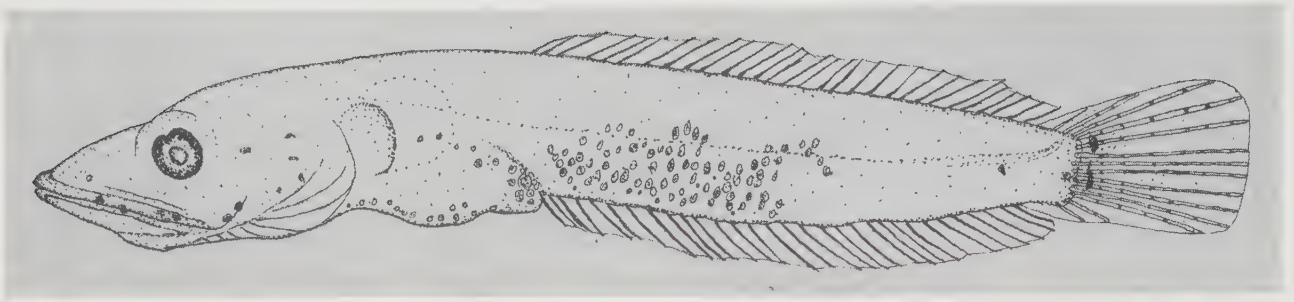


Fig. 45: Tommyfish (*Limnichthys rendahli*) larva (14.5 mm SL).

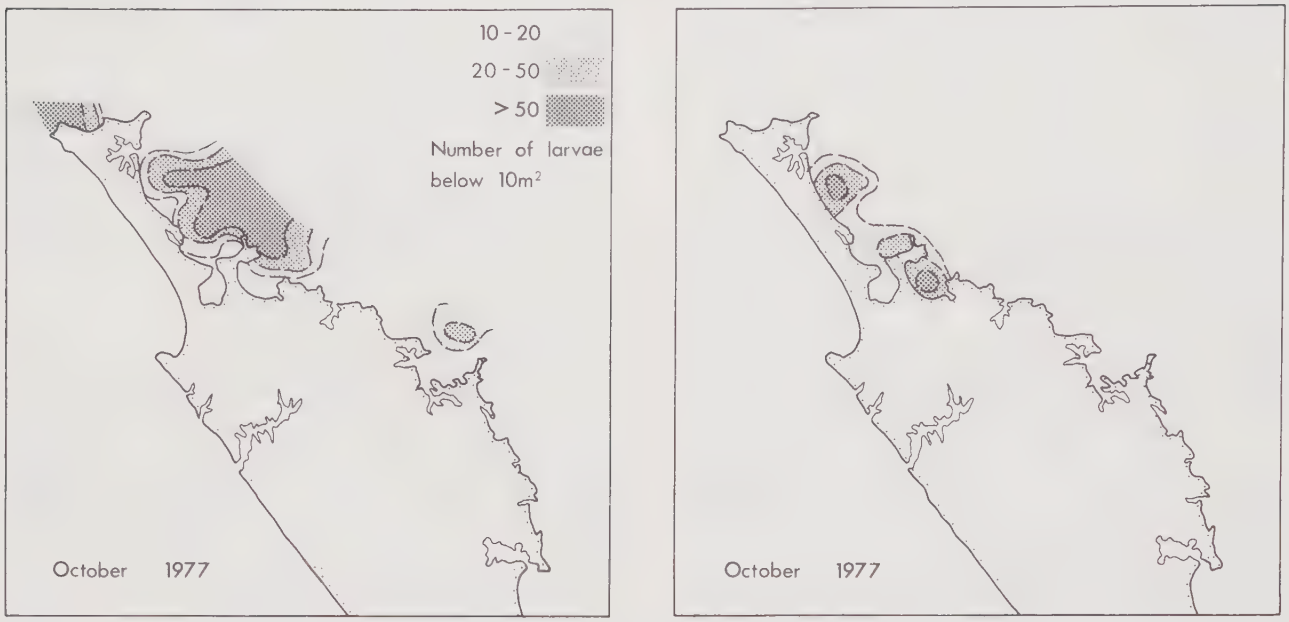


Fig. 46: Distribution of creediid larvae off east Northland. Left: tommyfish; right: sand diver.

Fig. 47: Sand diver (*Tewara cranwellae*) larva (16.7 mm SL).

had fin ray counts of 34 dorsal, 36 anal and 35 dorsal, 35 anal respectively. Some of these are slightly lower than the minima recorded by Nelson (34 dorsal, 37 anal), probably because the specimens were not fully developed.

Sand diver larvae were taken at 9 stations in October 1977, and their distribution (Fig. 46 right) was similar to that of tommyfish. In December 1977 they were much less abundant and were found at only 5 stations, which suggests that they have a similar spawning period to tommyfish.

The absence of creediid larvae in the outer Hauraki Gulf may have been because sampling took place after the spawning season.

Family Uranoscopidae

Spotted stargazer *Genyagnus monopterygius* (Bloch and Schneider, 1801)

Robertson (1975) described the spotted stargazer egg. Crossland (1981) described and figured the eggs and larvae and also recorded their distribution in the Hauraki Gulf.

During this study eggs and larvae of spotted stargazer were taken only occasionally. Eggs were recorded at 1 station in the outer Hauraki Gulf in December 1976 and at 2 stations on each of the east Northland cruises. Larvae were taken at 2 stations off east Northland in December 1977.

Families Blenniidae, Clinidae, and Tripterygiidae

Blennies

Larvae of these families of small fishes (the adults of which lay demersal eggs) were common in the plankton. Most were of the family Tripterygiidae. Further identification was not attempted.

In the outer Hauraki Gulf blenny larvae were abundant in December 1976, but less so in February 1978. Off east Northland they were extremely abundant in October 1977; frequently several hundred were taken at a single station, and once, over a thousand were recorded. On this cruise their numbers were exceeded only by the exceptionally large hauls of pilchard larvae. In December 1977 they were less common, but still occurred in large numbers and, as there were fewer pilchard larvae present, they were the most abundant type of larva taken.

The seasonal distribution observed during this study and by Crossland (1981) showed that blennies are winter-spring spawners.

Family Eleotridae

Graham's gudgeon *Grahamichthys radiatus* (Quoy and Gaimard, 1837)

Larvae of this small species (the adults of which lay demersal eggs) were figured by Crossland (1981).

A few larvae were taken at 3 stations in the outer Hauraki Gulf in February 1978. Off east Northland they were common and were recorded at 8 stations in October 1977 and 11 stations in December 1977, when they were slightly more abundant.

Family Gempylidae

Barracouta *Thyrsites atun* Euphrasen, 1791

The barracouta egg was described by Robertson (1975). Information on the distribution of eggs and larvae in south-eastern New Zealand and drawings of pre-juveniles were given by Robertson and Mito (1979). Two smaller specimens are shown in Fig. 48.

Six barracouta larvae were taken off east Northland in October 1977 at 2 stations, 1 off North Cape and the other offshore from Great Exhibition Bay.

Family Trichiuridae

Frostfish *Lepidopus caudatus* (Euphrasen, 1778)

Robertson (1980b) described and figured the eggs and larvae of frostfish and gave information on spawning.

Off east Northland a few frostfish eggs were taken at 2 stations in October 1977 and at 1 station in December 1977. Several larvae were taken at 3 stations in October 1977. These larvae were in the same haul as the eggs or were at stations close to where eggs were recorded. The sea surface temperature was 15.0–15.8 °C, which is lower than the spawning range given by Robertson (17.0–22.0 °C).

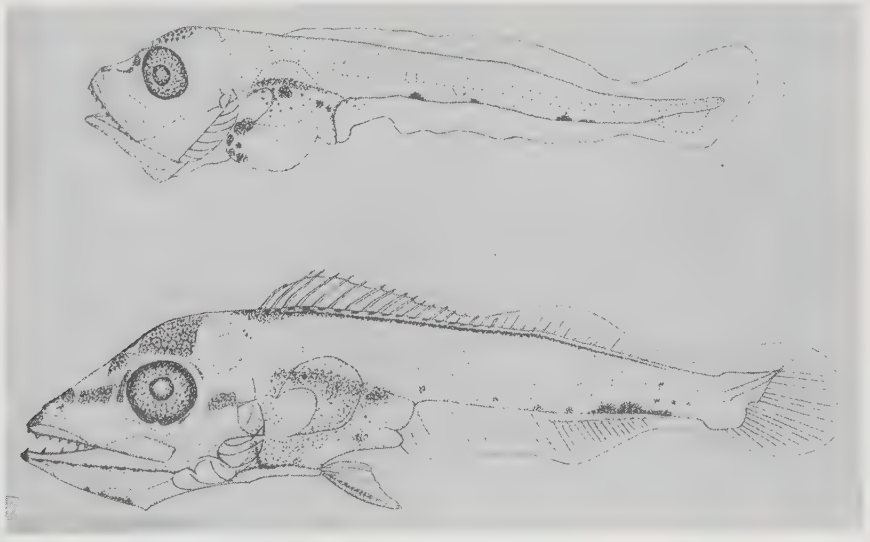


Fig. 48: Barracouta (*Thyrsites atun*) larvae (6.6, 9.9 mm SL).

Family Scombridae

Blue mackerel *Scomber australasicus* Cuvier and Valenciennes, 1831

Crossland (1981) described and figured the eggs and larvae and gave information on spawning in the inner Hauraki Gulf.

Outer Hauraki Gulf. Blue mackerel eggs were abundant during December 1976, but their distribution was patchy (Fig. 49). The main concentration was between Bream Head and the Hen and Chicken Islands, with a smaller one north-west of Little Barrier Island. In February 1978 they were not common and only 2 small patches were found. These were near the Hen and Chicken Islands and north of Little Barrier Island.

Larvae were abundant in December 1976 and several hundred were frequently taken in a single haul. They were most common along the western side of the study area (Fig. 50), particularly between Cape Rodney and Little Barrier Island. In February 1978, though larvae were recorded at 13 stations, they were much less abundant and the only significant concentration was east of Great Barrier Island.

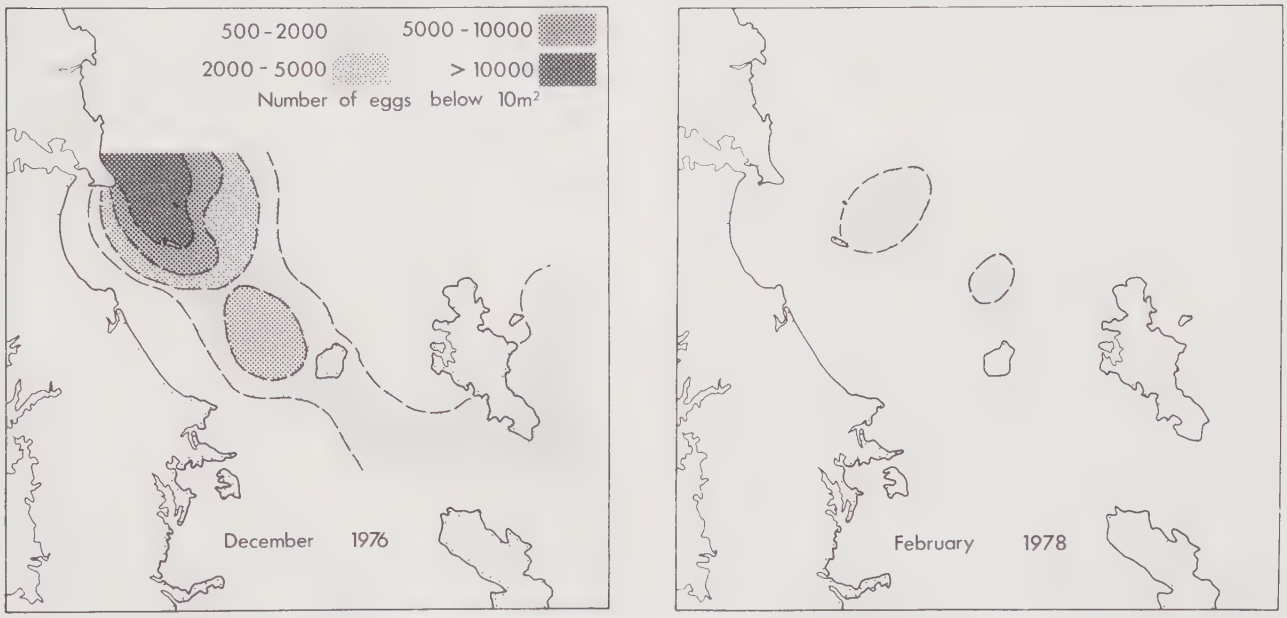


Fig. 49: Distribution of blue mackerel eggs in the outer Hauraki Gulf.

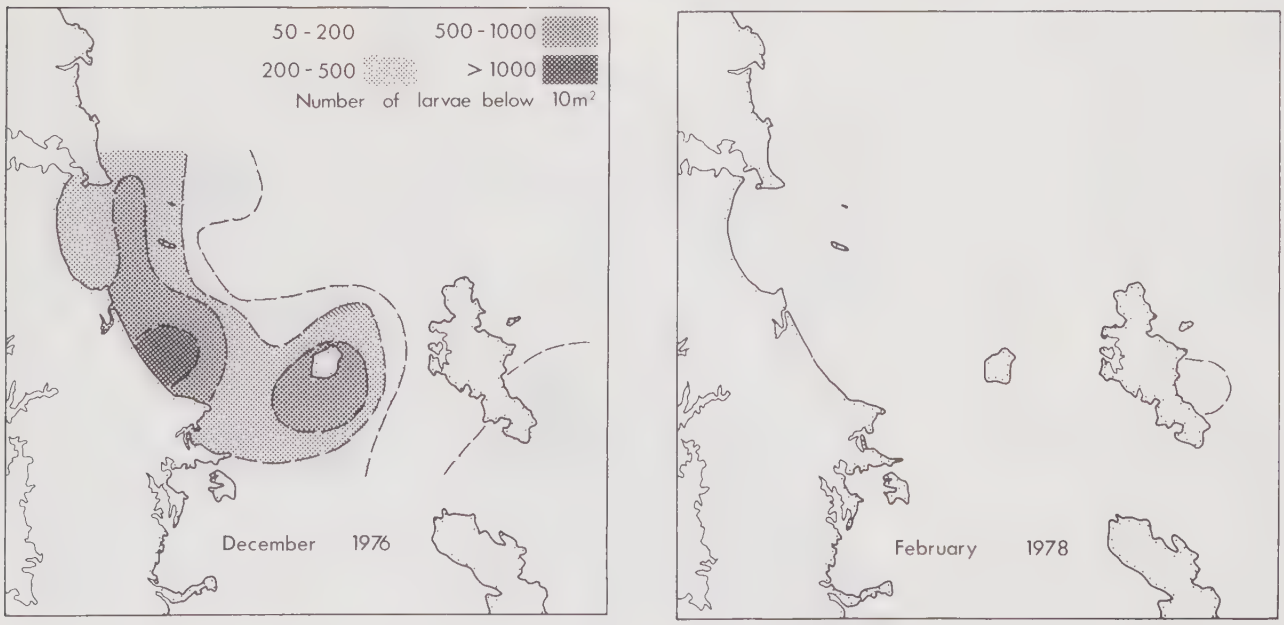


Fig. 50: Distribution of blue mackerel larvae in the outer Hauraki Gulf.

East Northland. During October 1977 there was a dense egg concentration in Great Exhibition Bay (Fig. 51): at station 27, 3900 eggs were recorded and at station 28, 5000. Elsewhere eggs were taken at all stations from Bream Head to the Bay of Islands, but not in large numbers. In December 1977 there was only 1 small concentration in the same place as in October 1977.

In October 1977 many larvae were taken close to where the eggs were in Great Exhibition Bay (Fig. 52). However, the larvae were dispersed more widely, both to the north and south, and they were a few nautical miles further offshore than the eggs. In December 1977 only occasional larvae were recorded.

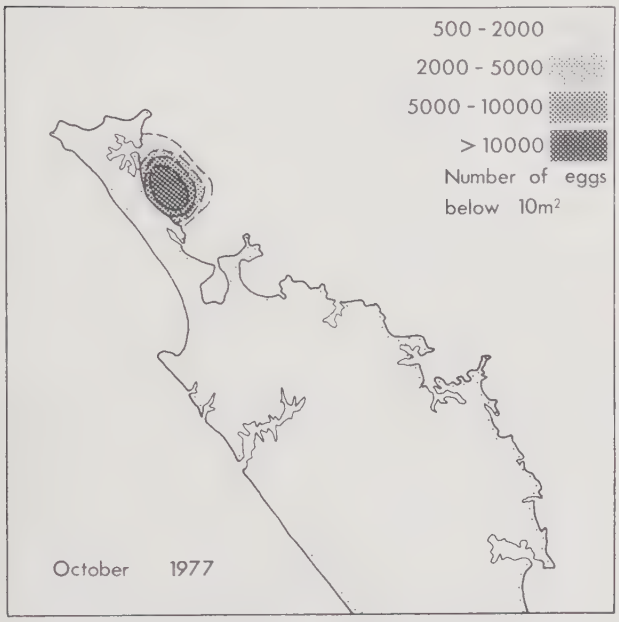


Fig. 51: Distribution of blue mackerel eggs off east Northland.

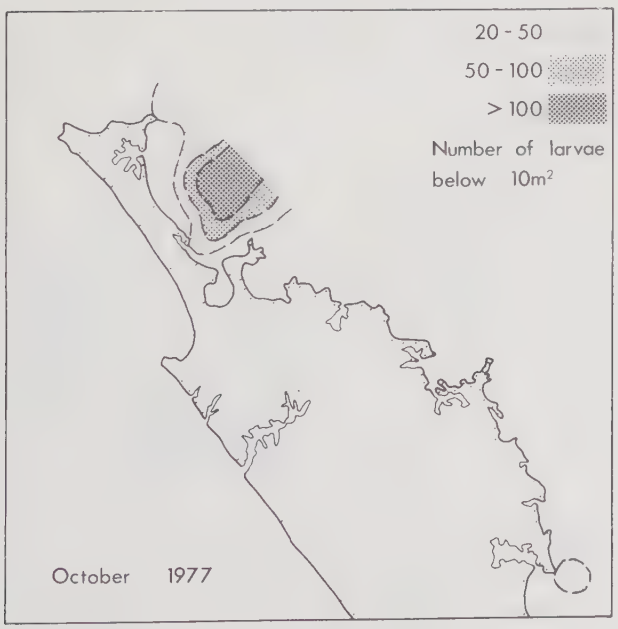


Fig. 52: Distribution of blue mackerel larvae off east Northland.

Spawning of blue mackerel in the Hauraki Gulf has been recorded from November to at least January (Crossland 1981). The results here show that spawning can begin earlier and at lower temperatures than previously recorded. The range of sea surface temperatures in which I have taken blue mackerel eggs is from 15 to 22 °c. Because of this wide range, and the mobile schooling habits of the species, an extended series of sampling cruises would be necessary to determine its spatial and seasonal spawning limits. Nevertheless, results suggest that there are appreciable stocks of this lightly exploited fish off north-east New Zealand.

Family Gobiesocidae

Clingfishes

Adults of these small littoral fishes lay demersal eggs. Their larvae were recognised by their modified pelvic fins, which form a sucking disc. They were common components of the plankton off east Northland. Two species were recognised (Figs. 53 and 54), but separate records were not kept. In October 1977 they were taken at 18 stations, with a maximum of 195 being taken at station 24. In December 1977 they were found at 24 stations.

Fig. 53: Gobiesocid larvae, species 1 (6.3 mm NL, 7.2 mm SL).

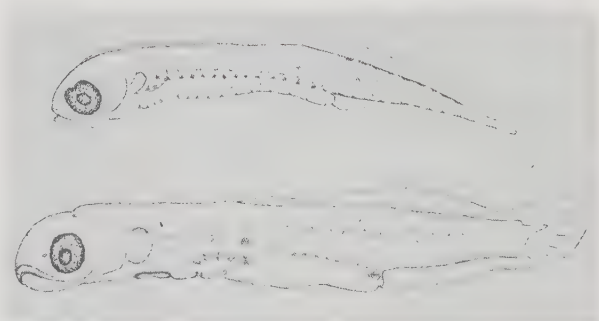


Fig. 54: Gobiesocid larvae, species 2 (4.6 mm NL, 6.9 mm SL).

Family Bothidae

Crested flounder *Lophonectes gallus* Günther, 1880

Information on the spawning of crested flounder was given by Robertson (1973), and the eggs and larvae were described and figured by Crossland (1981).

Eggs and larvae were taken during this study, but only in the outer Hauraki Gulf. Eggs were not common in December 1976, but were in February 1978, when the main spawning centres were around the Hen and Chicken Islands and north and east of Great Barrier Island (Fig. 55). Spawning appears to take place in depths greater than 75 m.

Unlike the eggs, larvae were common in December 1976. They were most abundant north-west of Little Barrier Island, with smaller numbers being taken east of Great Barrier Island (Fig. 56). Because of their distance from the periphery of the study area, these larvae were more likely to have been from an earlier spawning within the study area, rather than to have drifted in from outside. In February 1978 larvae were again common, and their distribution was complex. There were centres of abundance between Bream Head and Bream Tail and both west and east of Great Barrier Island.

Crossland (1981) postulated that there was a crested flounder spawning ground north of the inner Hauraki Gulf. The results above confirmed this and established that the spawning ground extends from the Hen and Chicken Islands to Little Barrier Island, with a second spawning ground east of Great Barrier Island.

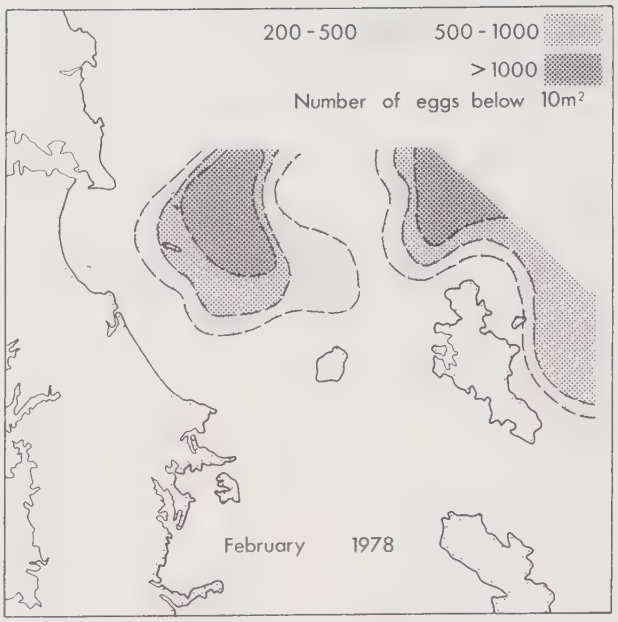


Fig. 55: Distribution of crested flounder eggs in the outer Hauraki Gulf.

Family Pleuronectidae

Several pleuronectids have similar eggs (diameters of 0.575–0.725 mm; non-segmented yolk; and several small oil droplets (Robertson 1975)) and it is not possible to identify them separately in plankton samples (Colman 1973, Crossland 1981). Three such species occur in the study area: sand flounder (*Rhombosolea plebeia* Richardson, 1843), yellow-belly flounder (*R. leporina* Günther, 1873), and speckled sole (*Peltorhamphus latus* James, 1972).

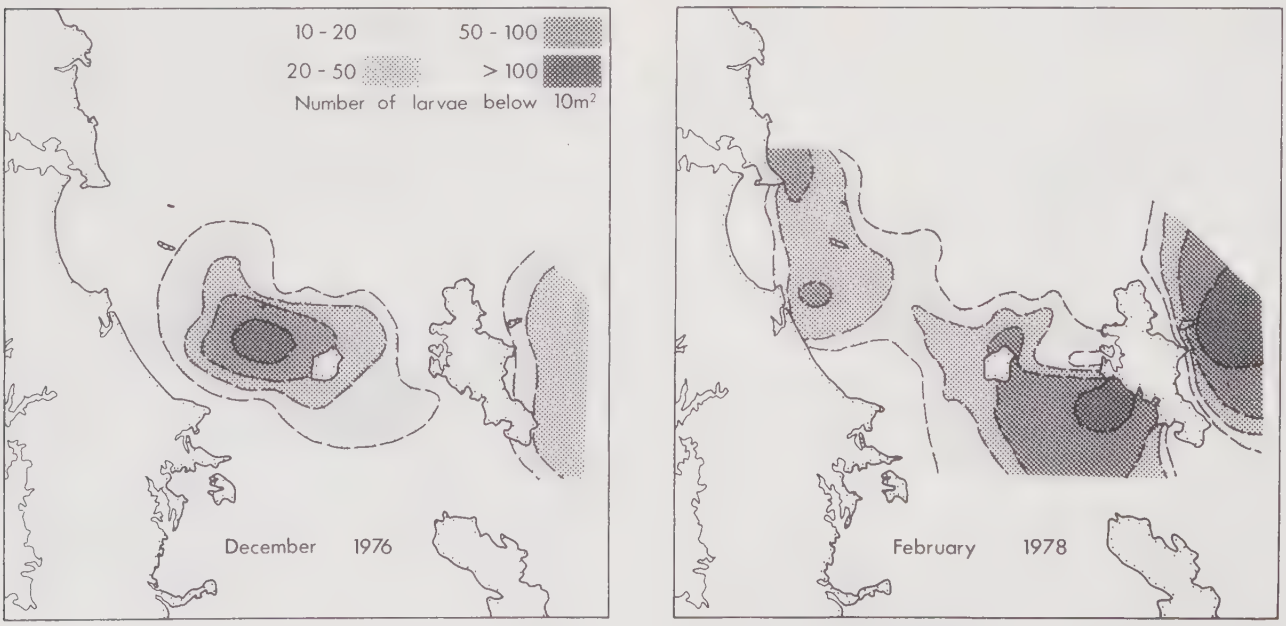


Fig. 56: Distribution of crested flounder larvae in the outer Hauraki Gulf.

Pleuronectid eggs. Very few were taken except at stations 1 and 2 (the 2 inner stations) in the Hauraki Gulf. Off east Northland the few that were recorded were from stations near large bays.

Flounder larvae. Larvae of the 2 species of *Rhombosolea* could not be distinguished from each other. They were neither abundant nor widespread and were recorded only from stations where pleuronectid eggs were taken.

Speckled sole larvae. Larvae of this species were described and figured by Crossland (1981).

These larvae were more common than flounder larvae and were usually taken in the same areas. A few were recorded in the outer Hauraki Gulf in December 1976. In February 1978 many were taken at Kawau Island, Cape Rodney, and in Port Abercrombie, Great Barrier Island. Off east Northland in October 1977 they were found at 8 stations in moderate numbers, being most abundant in the Bay of Islands and off Whangaroa Harbour. They were taken at only 1 station in December 1977.

These results, and those of Crossland (1981) show that, though speckled sole spawn most heavily in mid spring, their spawning season in northern New Zealand can extend from at least October to February.

Lemon sole *Pelotretis flavilatus* Waite, 1911

Lemon sole eggs were described and figured by Robertson (1975). They are larger than eggs of the pleuronectids above and can be distinguished from them. The early life history of lemon sole was studied by Rapson (1940) in Tasman Bay. Rapson figured the larvae, but the larger ones appear more likely to be those of a species of *Peltorhamphus*. The lemon sole larva (Fig. 57) has a conspicuous speckled appearance and a noticeably rounded belly.

Both eggs and larvae were recorded during this study, but only off east Northland. A few eggs were taken in distinct localities. In October 1977 they were found at Sandy Bay, off Doubtless Bay, and in the North Cape area (Fig. 58). In December 1977 there were none off Doubtless Bay, but they were recorded in the other 2 areas. Sea bottom temperatures at stations where eggs were taken ranged from 13.6 to 16.0 °C.

A few larvae were taken in October 1977 at station 21, slightly north of the spawning area off Doubtless Bay. In December 1977 they were recorded at stations 3, 4, and 5, near and north of the eggs taken at Sandy Bay. The maximum number recorded in a single haul was 12 at station 5. Sizes of larvae ranged from 3.0 to 6.6 mm SL.

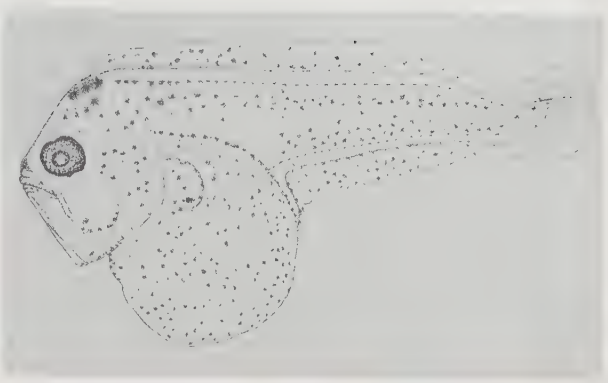


Fig. 57: Lemon sole (*Pelotretis flavilatus*) larva (6.6 mm SL).

Family Balistidae

Leather jacket *Novodon convexirostris* (Bloch and Schneider, 1801)

Crossland (1981) found that leather jacket eggs were widespread and abundant in the spring plankton of the Hauraki Gulf. The egg was described by Robertson (1975), and the eggs and larvae were figured by Crossland (1981).

Outer Hauraki Gulf. Leather jacket eggs were among the commonest types and were taken in all samples except 3 during the 2 cruises. In December 1976 the centre of abundance extended from the Hen and Chicken Islands to Little Barrier Island (Fig. 59). In February 1978 they were less abundant, but had a similar distribution, except that they were more common east of Great Barrier Island.

In the inner Hauraki Gulf the preferred spawning temperature range was from 14.0 to 17.0 °C (sea bottom), with peak spawning at 15.4 °C. Sea bottom temperatures were not available for the December 1976 cruise, but in February 1978 the observed spawning correlated well with these temperatures. East of Great Barrier Island spawning probably occurs later than elsewhere, because temperatures are lower and take longer to reach the preferred range.

Crossland (1981) noted the scarcity of leather jacket larvae in the inner Hauraki Gulf compared with the abundance of eggs. This was also the situation on the 2 cruises to the outer Hauraki Gulf, when larvae were recorded at only 1 station (in February 1978).

East Northland. Eggs were taken regularly in October 1977, but they were not as abundant as they were in the outer Hauraki Gulf. They were commonest off Bream Head and in the Bay of Islands, Doubtless Bay, and Great Exhibition Bay (Fig. 60). In December 1977 they were not common and the only significant catches were off Bream Head. The

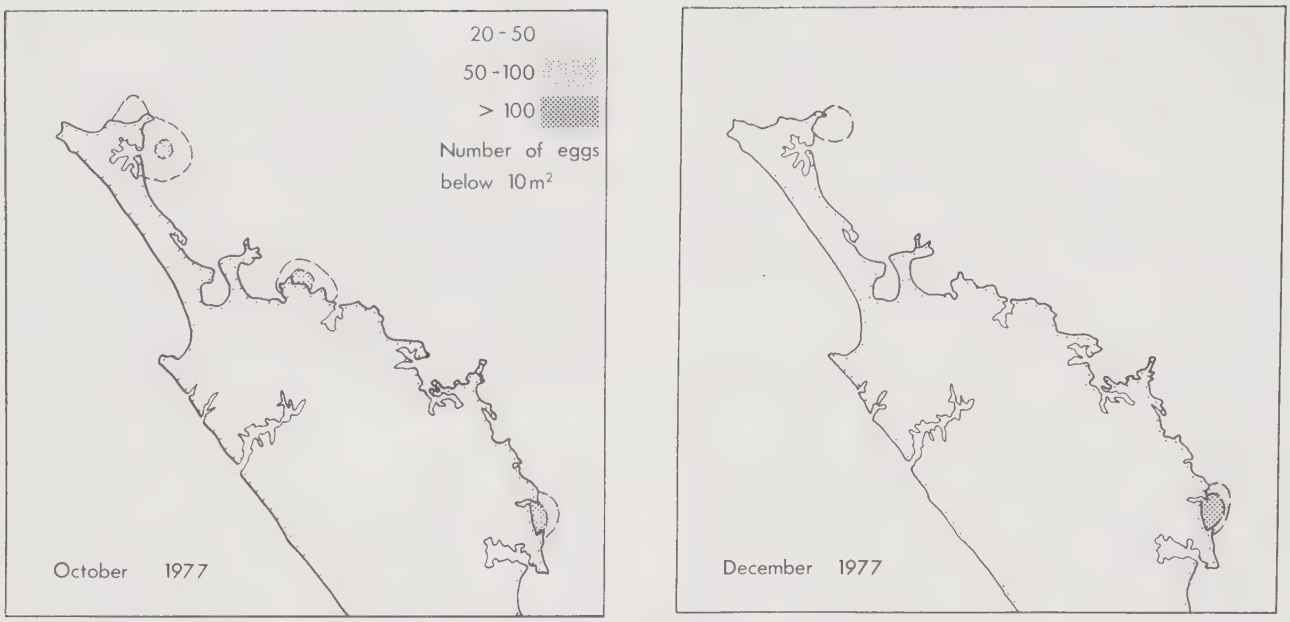


Fig. 58: Distribution of lemon sole eggs off east Northland.

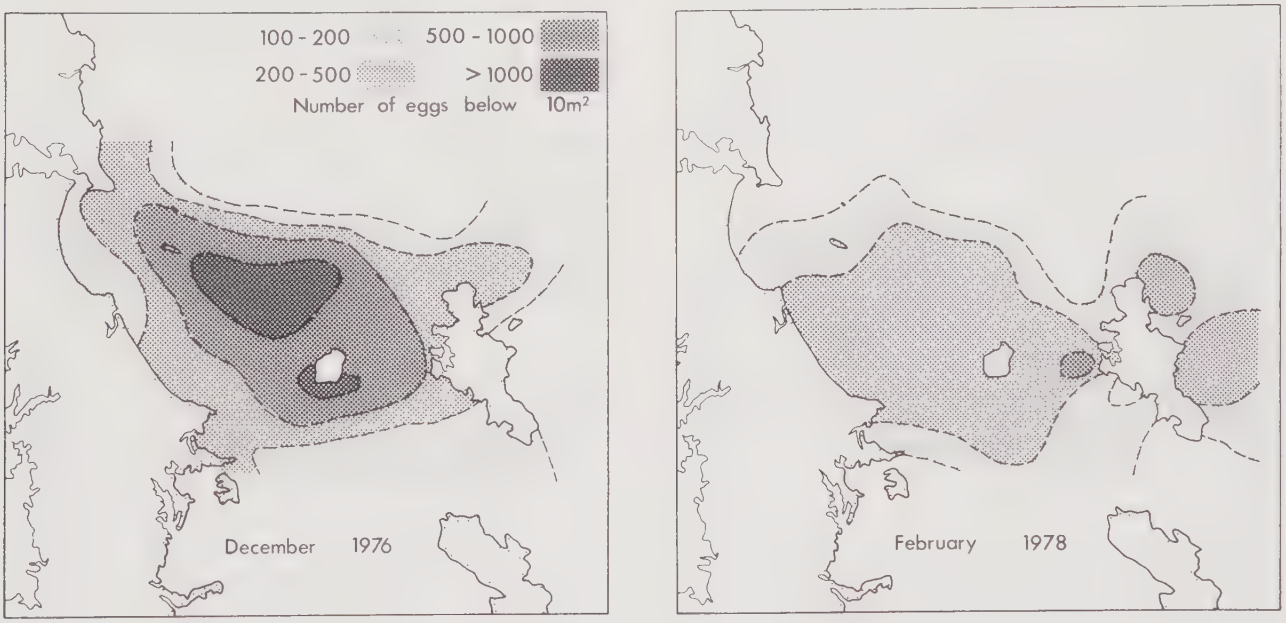


Fig. 59: Distribution of leather jacket eggs in the outer Hauraki Gulf.

smaller number of eggs recorded in December 1977 may have been due to the low sea bottom temperatures.

In contrast to the eggs, larvae were more common off east Northland than in the outer Hauraki Gulf. During October 1977 larvae were recorded at 12 stations. They were taken near some of the egg concentrations (Fig. 61). The greatest numbers were recorded outside the Bay of Islands, with 22 larvae being taken at station 13 (Cape Wiwiki), the most I have recorded from a single haul. Smaller numbers were taken in Rangaunu Bay and around North Cape. In December 1977 a few larvae were recorded at 5 stations.

Family Diodontidae

Porcupine fish *Allomycterus jaculiferus* (Cuvier, 1818)

A single larva was taken off Simmonds Island in October 1977.

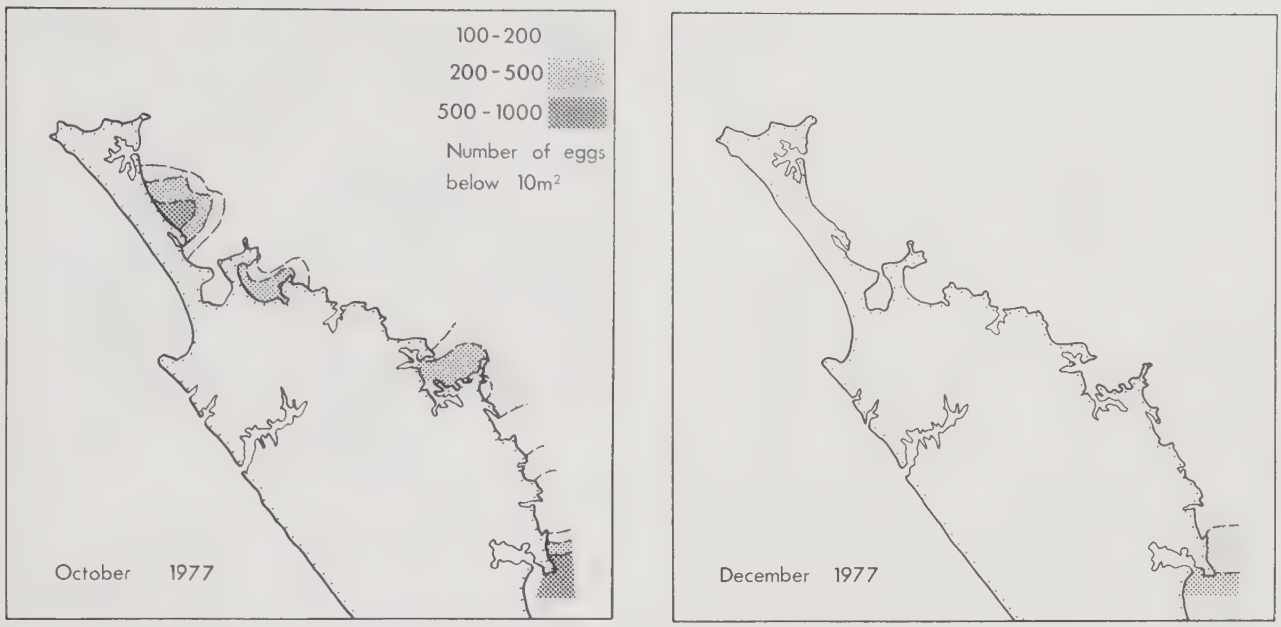


Fig. 60: Distribution of leather jacket eggs off east Northland.

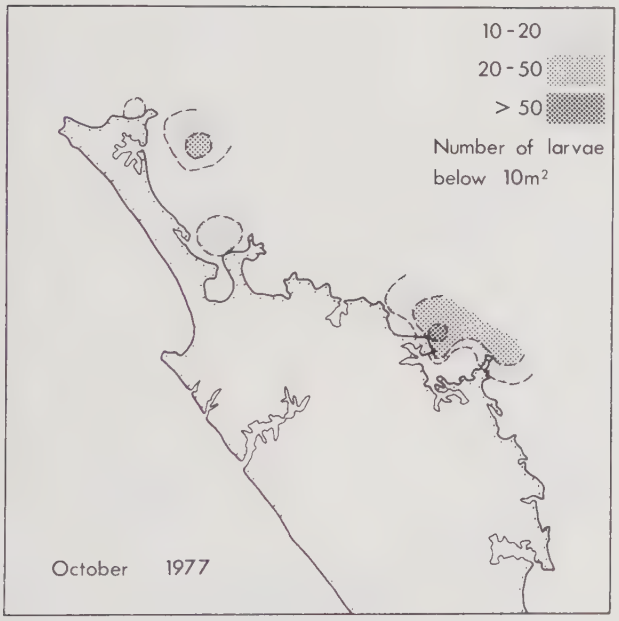


Fig. 61: Distribution of leather jacket larvae off east Northland.

Unidentified eggs and larvae

Unidentified egg 1

This egg had a diameter of 0.80–0.89 mm; a narrow perivitelline space; a segmented yolk; and a single, pale yellow oil droplet, 0.20–0.25 mm in diameter. It was figured by Crossland (1981). During this study it was recorded only in the outer Hauraki Gulf.

In December 1976 it was taken in moderate numbers. Its distribution was patchy (Fig. 62), with spawning centres around Little Barrier Island, the Hen and Chicken Islands, the Mokohinau Islands, and north-east of Great Barrier Island. It was more common in February 1978 and again had a patchy distribution, with centres of abundance off Cape Rodney, the Hen and Chicken Islands, and north-east Great Barrier Island.

This egg resembles the egg of trevally described by James (1976), but there are slight differences. James recorded the trevally egg as having a moderately segmented yolk, whereas this egg has strong segmentation in the early stages. The trevally egg has an unpigmented embryo, whereas this egg has a pigmented embryo. However, these differences may be because the eggs described by James were raised artificially. The distribution of unidentified egg 1 is consistent with what could be expected from the known habits of trevally, which commonly school around points and open-shore islands and are summer spawners. However, these facts may fit another carangid, koheru, whose eggs and spawning season are not known.

Unidentified egg 2

This egg had a diameter of 1.12–1.22 mm; a very narrow perivitelline space; a segmented yolk; and no oil droplet. It was figured by Crossland (1981). The advanced embryo was darkly pigmented. It may be the egg of a trachichthyid, possibly slender roughy (*Optivus elongatus*) (see page 25).

Unidentified egg 3

This egg had a diameter of 1.02–1.12 mm; a narrow perivitelline space (0.08 mm); a non-segmented yolk;

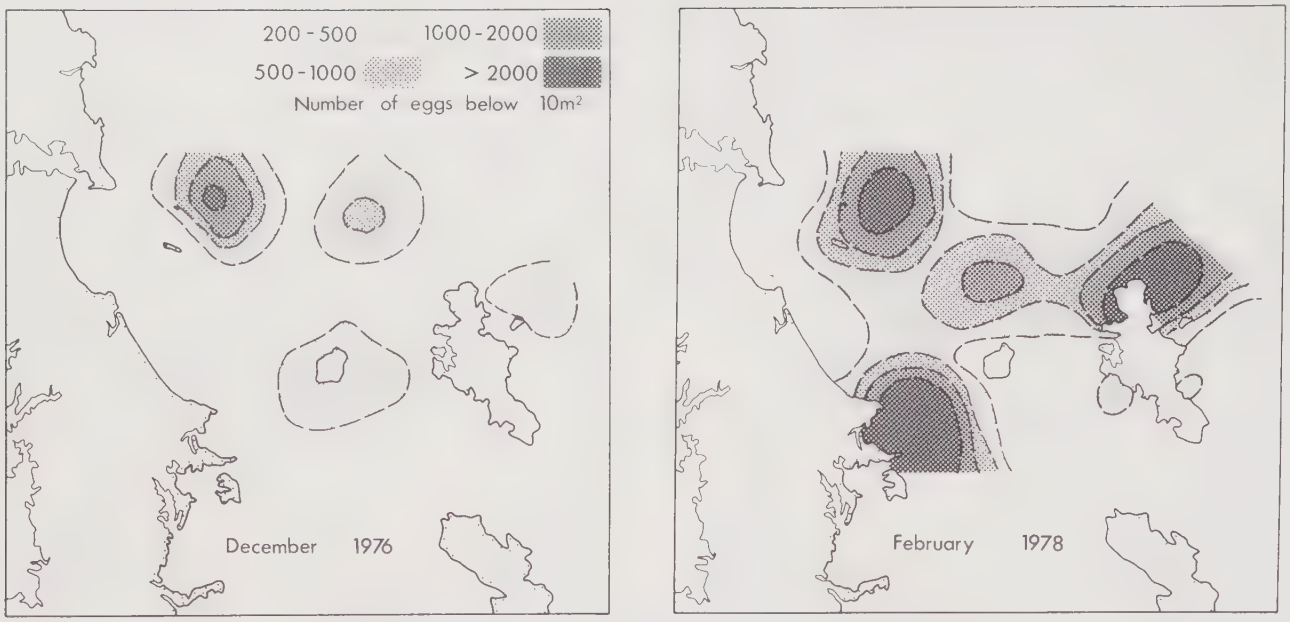


Fig. 62: Distribution of unidentified egg 1 in the outer Hauraki Gulf.

and 2–8 greenish oil droplets, with a maximum diameter of 0.05 mm. It was figured by Crossland (1981). The egg is similar to, but slightly smaller than, the egg of the latrid *Mendosoma lineatum* Guichenot, 1849 described by Robertson (1975).

This egg was taken at only 1 station in the outer Hauraki Gulf (in February 1978). Off east Northland it was found at 22 stations in October 1977 (Fig. 63). At station 11 in the Bay of Islands 42 eggs were taken. This was more than the combined total of all other stations on all 4 cruises. In December 1977 it was recorded at 16 stations scattered throughout the study area.

Unidentified egg 4

This egg (Fig. 64) had a diameter of 1.60–1.71 mm; a non-segmented yolk; and a cluster of 10–16 oil droplets, 0.06–0.15 mm in diameter. The late stage embryo had many melanophores.

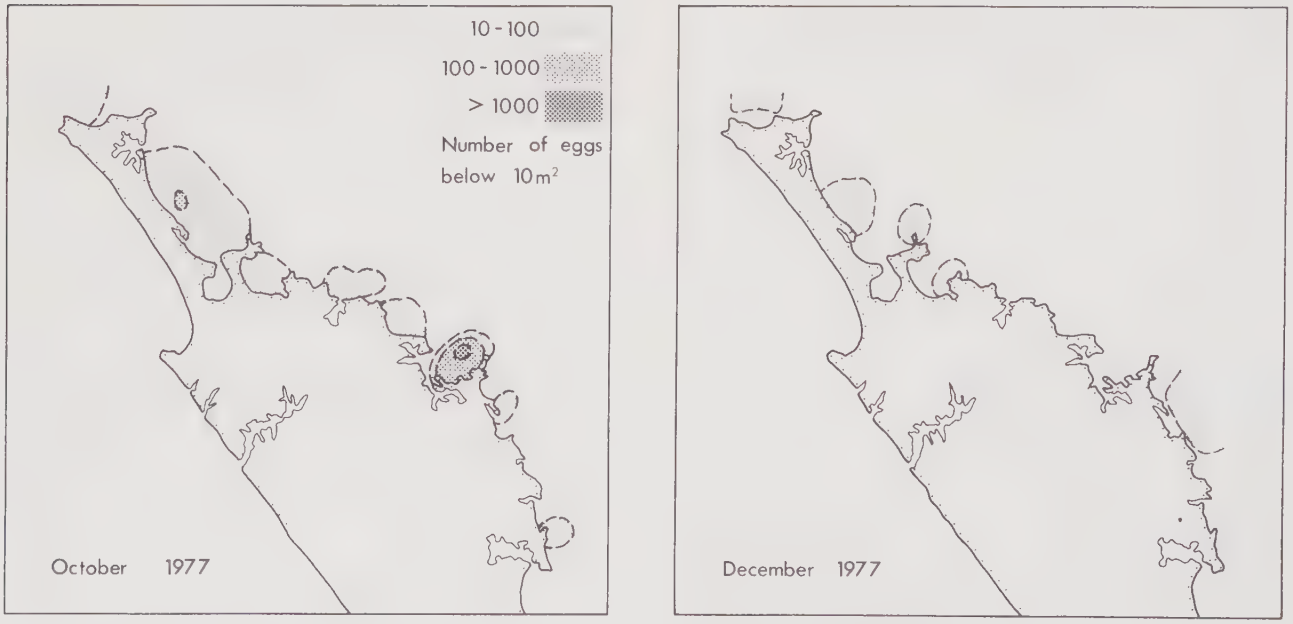


Fig. 63: Distribution of unidentified egg 3 off east Northland.

Fig. 64: Unidentified egg 4.

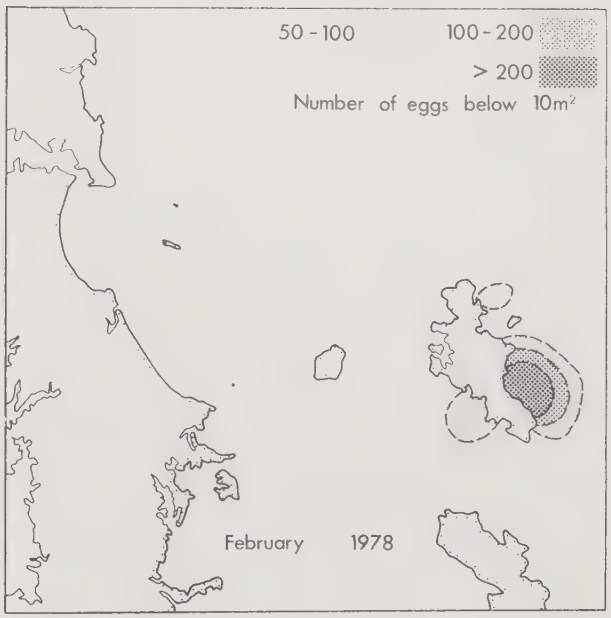


Fig. 65: Distribution of unidentified egg 4 in the outer Hauraki Gulf.

The egg was taken occasionally in the outer Hauraki Gulf in December 1976, but was more common in February 1978, when small concentrations were found around Great Barrier Island (Fig. 65). A few were taken off east Northland on the December 1977 cruise. This egg seems to be that of a summer-spawning inshore species.

Unidentified egg 5

This egg had a diameter of 0.82–0.91 mm; a non-segmented yolk; and a single oil droplet, 0.14–0.19 mm in diameter. It resembles the labrid eggs discussed above, but its average size is greater.

It was recorded only off east Northland. During October 1977 it was abundant in several distinct areas: Cape Brett, off Whangaroa Harbour, Doubtless Bay, Great Exhibition Bay, and North Cape (Fig. 66). In December 1977 it was much less common and was found mainly in 2 areas.

Although this egg is similar to that of banded parrotfish, it is unlikely to be of that species because its distribution suggests that it is the egg of a schooling species, which banded parrotfish is not.

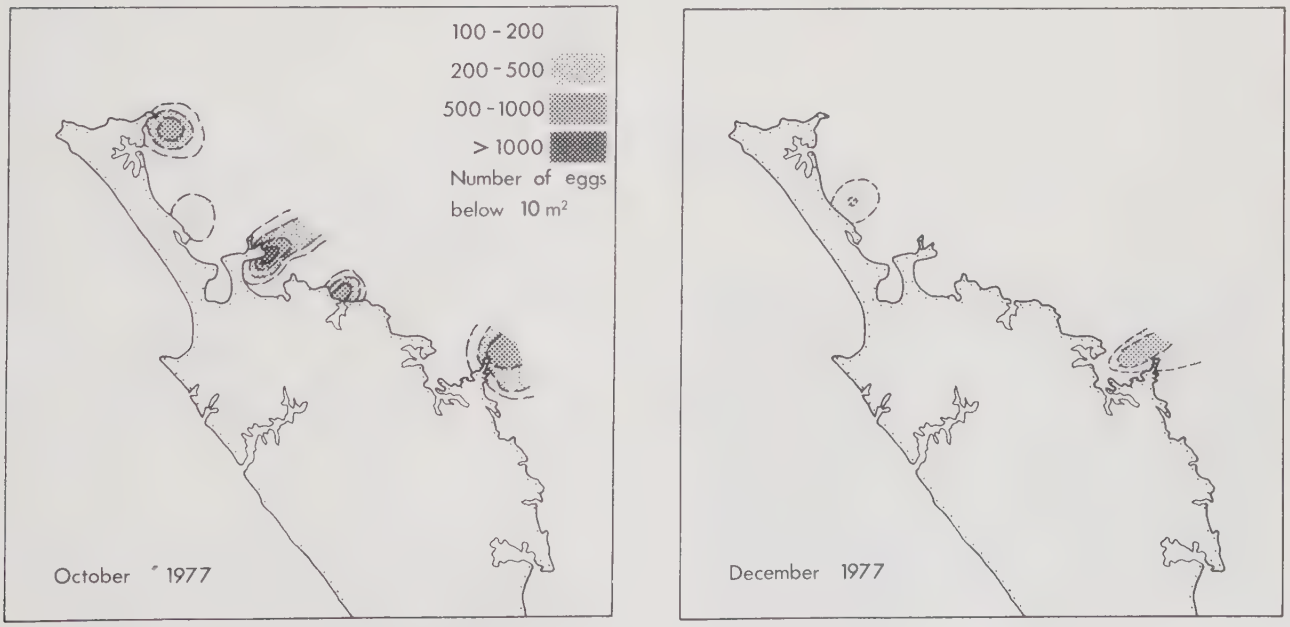


Fig. 66: Distribution of unidentified egg 5 off east Northland.

Unidentified eel egg

This egg (Fig. 67) had a diameter of 4.11–4.64 mm; a perivitelline space of 0.47–0.63 mm; a dense, finely segmented yolk; and no oil droplet. Only early stage eggs were taken.

The egg was recorded at stations 14 and 16 on the east side of Great Barrier Island in February 1978.

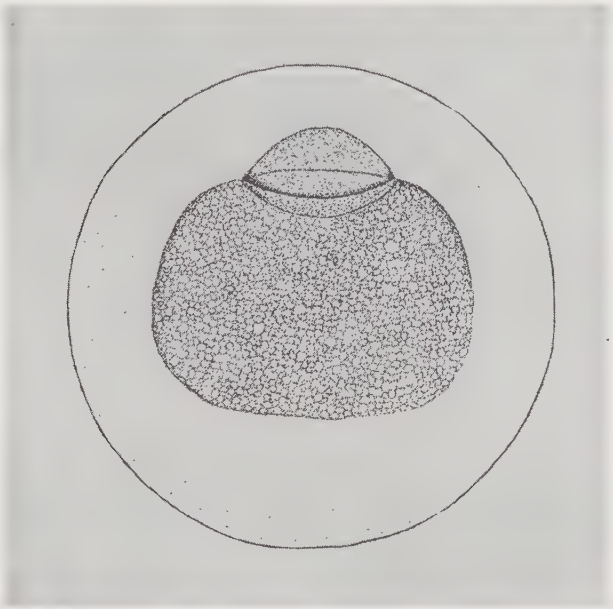


Fig. 67: Unidentified eel egg.

Unidentified larva 1

Two specimens of an unrecorded larva (Fig. 68) were taken at station 34 in Spirits Bay in October 1977. These larvae could not be identified, even to family level.

Unidentified larva 2

This larva (Fig. 69) was taken during the October 1977 cruise off east Northland. In general body form, and presence of preopercular spines, it resembles larvae of the serranid subfamily Anthiinae. However, no larva was large enough to enable a comparison of complete fin ray counts. The largest larva taken had 8 dorsal spines and 2 anal spines, compared with the 10 and 13 spines respectively that are found in the Anthiinae.

This larva was recorded at 7 stations and was most abundant off North Cape (station 30), where 96 specimens were taken (Fig. 70).

Fig. 68: Unidentified larva 1 (8.8, 12.2 mm SL).

Fig. 69: Unidentified larva 2 (3.8 mm NL, 5.2, 7.3 mm SL).

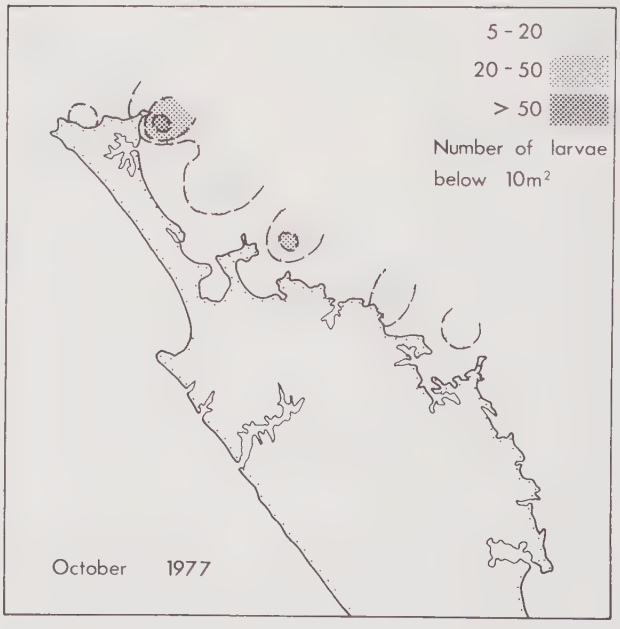


Fig. 70: Distribution of unidentified larva 2 off east Northland.

DISCUSSION

The importance of the outer Hauraki Gulf as a spawning ground for many fishes has been shown by the large number of eggs recorded during this study. On the December 1976 cruise the average number of eggs below 10 m^2 (9840) was higher than that recorded by Crossland (1981) on any cruise to the inner Hauraki Gulf, where the maximum cruise averages recorded were 6870 (1974–75) and 4260 (1975–76). In February 1978 the average (3900) was again high in the outer gulf.

Crossland (1981, Table 2) gave information on the preferred spawning temperatures of 11 common species which spawned between October and January in the inner Hauraki Gulf. From these findings, sea temperatures in the outer gulf in December 1976 appear to have been close to optimum for the spawning of several species (snapper, jack mackerel *T. novaezelandiae*, red gurnard, and leather jacket). Temperatures were also favourable in February 1978.

For all species combined, the most important spawning areas in the outer gulf were off Bream Head and between the Hen and Chicken Islands and Great and Little Barrier Islands. These areas are bounded approximately by the 50-m and 100-m depth contours.

The influence of the East Auckland Current on the dispersal of larvae southwards into the Hauraki Gulf was postulated by Crossland (1981) and was evident during the December 1976 cruise. Figure 71 shows the assumed movements of larvae of the principal species. The figure was derived by plotting the displacement of the centres of larval abundance from the centres of egg abundance.

The results from the 2 cruises off east Northland were probably affected by the cold spring of 1977. The average air temperatures at the Kaitaia meteorological station from October to December 1977 were 1.0–1.4 °C below the long-term average (Table 3). Sea temperatures were particularly low during December, when both surface and bottom temperatures were 1–2 °C lower than those Mercer (1979) recorded in the same area during November 1973. These low sea temperatures and the bottom to surface profiles, which often showed thermoclines near the surface, suggested there was an upwelling of cold water on to the shelf, possibly as a result of long periods of south and south-west winds driving the surface water offshore. Because of these conditions the spring-spawning fish, such as snapper and *T. novaezelandiae*, did not spawn as heavily as expected during the study period.

The effect of offshore winds on the distribution of larvae was noticeable during October 1977. Larvae of 4 (leather jacket, snapper, red gurnard, and *T. novaezelandiae*) out of 5 common species which spawned in the Bay of Islands were distributed several nautical miles north or north-east of the eggs; whereas larvae of the fifth (pilchard) showed no movement from where the eggs were taken. At Great Exhibition Bay larvae of leather jacket and blue mackerel were similarly displaced offshore.

As a result of this study and earlier ones (Cassie 1956a, Colman 1973, Crossland 1980, 1981) the spring and summer ichthyoplankton of the Hauraki Gulf is reasonably well known. However, more work is needed to define the spawning areas and seasons of the main commercial species off east Northland. Some

TABLE 3: Mean air temperatures (°C) at Kaitaia, Northland (New Zealand Meteorological Service data)

Period	Oct	Nov	Dec
1941–70	14.8	16.3	18.0
1977	13.8	14.9	16.9

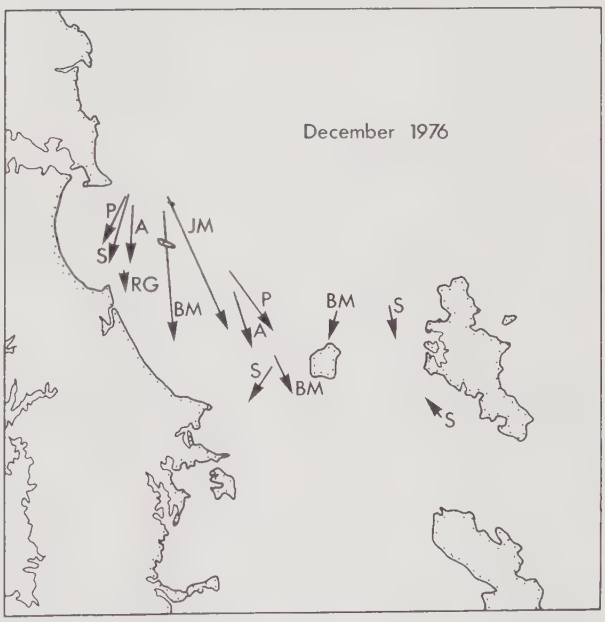


Fig. 71: Assumed drift of larvae in the outer Hauraki Gulf. Arrows show displacement between centres of egg abundance and centres of larval abundance. (A, anchovy; BM, blue mackerel; RG, red gurnard; JM, jack mackerel *T. novaezelandiae*; P, pilchard; S, snapper.)

species, such as pilchard and blue mackerel, are not exploited now, but may contribute to the commercial fishery in the future. Knowledge of their spawning may be important, as the spawning aggregations may be the best stocks to harvest. Fisheries for snapper are continuing to develop along the north-east coast. With further information on spawning, stock sizes could be estimated for areas like the Bay of Islands, Doubtless Bay, and Rangaunu Bay.

Finally, eggs and larvae of many fishes off northern New Zealand are not described. Although not all of these species may be commercially valuable, their early life stages need to be recognised to help in the identification of the plankton.

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APPENDIX

TABLE 4: Kinds and densities (number per 100 m^3) of eggs collected in the outer Hauraki Gulf, 13–16 December 1976

Species	Station number* 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Engraulis australis	2313	61	6	18	0	0	4 178	34	6	2	1	0	0	9
Sardinops neopilchardus	35	4	0	10	0	0	2 792	26	2	0	0	6	23	23
Zeus faber	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Chelidonichthys kumu	0	0	15	0	41	64	0	4	0	0	2	1	7	0
Trachurus novaezelandiae	1 933	2 780	37	48	28	307	4 387	2 492	42	144	16	232	496	349
T. declivis	0	0	0	0	0	0	0	60	0	32	0	11	0	0
Chrysophrys auratus	1 089	1 191	23	38	66	188	1 310	87	1	14	1	48	43	11
Aldrichetta forsteri	6	0	0	0	22	13	19	0	0	0	0	0	0	0
Family Labridae	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Genyagnus monopterygius	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Scomber australasicus	6	0	0	1	0	3	4 919	553	8	30	0	4	21	9
Lophonectes gallus	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Family Pleuronectidae	178	50	11	1	0	24	0	0	1	0	0	0	0	0
Novodon convexirostris	20	79	40	48	38	48	57	0	2	2	3	42	37	20
Unidentified egg 1	0	0	0	0	0	0	0	260	0	77	0	0	39	3
Unidentified egg 2	0	0	2	0	0	0	0	0	0	2	0	13	37	60
Unidentified egg 4	0	0	0	0	0	0	0	0	0	2	0	0	0	0

Species	Station number 15	16	17	18	20	21	22	23	24	25	26	27	28	29
Engraulis australis	3	0	0	0	17	17	0	3	6	81	1 038	509	579	0
Sardinops neopilchardus	39	128	39	21	131	0	8	0	3	45	299	35	16	47
Zeus faber	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Chelidonichthys kumu	0	0	0	7	0	0	2	0	0	0	0	0	0	6
Trachurus novaezelandiae	515	354	99	117	1 073	1 158	884	310	113	738	142	361	1 196	656
T. declivis	0	0	0	2	0	0	0	32	7	7	4	0	0	0
Chrysophrys auratus	16	35	76	267	459	589	476	95	40	73	60	159	299	533
Family Labridae	0	0	6	0	0	0	0	0	0	0	0	0	8	0
Scomber australasicus	75	425	194	231	51	22	14	3	0	34	281	711	82	158
Family Pleuronectidae	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Novodon convexirostris	0	32	25	31	45	136	48	67	59	172	195	182	70	270
Unidentified egg 1	23	0	3	0	0	36	0	8	0	0	23	0	47	117
Unidentified egg 2	13	11	11	17	0	7	20	3	0	0	0	0	4	0
Unidentified egg 4	0	0	3	5	0	0	0	0	0	2	0	4	0	0

*Station 19 was not sampled.

TABLE 5: Kinds and densities (number per 100 m^3) of eggs collected in the outer Hauraki Gulf, 31 January–6 February 1978

Species	Station number 1	2	3	4	5	6	7	8	9	10	11	12	13	13N*	14	14N
Engraulis australis	995	186	31	3	0	1	0	0	0	0	4	3	0	0	0	6
Sardinops neopilchardus	0	0	0	0	0	0	0	494	0	0	0	3	3	0	6	0
Family Muraenidae	0	0	0	10	9	0	29	12	0	3	1	5	0	0	1	0
Gnathophis sp.	0	0	0	0	1	0	0	8	0	0	0	0	0	0	0	0
Zeus faber	0	0	3	0	0	0	0	8	2	0	0	0	0	1	0	0
Chelidonichthys kumu	0	0	0	0	0	0	4	20	3	1	0	0	0	0	0	0
Trachurus novaezelandiae	261	831	903	168	0	4	0	167	8	1	46	433	167	450	159	459
T. declivis	3	0	3	0	0	0	0	4	1	0	1	0	0	24	6	22
Chrysophrys auratus	183	206	38	10	0	1	4	24	1	0	12	31	21	32	37	39
Family Labridae	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	11
Lepidopus caudatus	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Scomber australasicus	0	0	0	0	0	0	0	118	4	1	2	46	10	16	79	0
Lophonectes gallus	0	0	0	0	0	0	0	187	9	0	89	5	73	56	61	22
Family Pleuronectidae	21	31	19	0	0	1	0	0	0	0	0	0	0	0	0	0
Novodon convexirostris	4	10	59	51	44	56	2	12	0	1	7	28	38	24	55	18
Unidentified egg 1	57	397	675	31	0	1	5	322	0	0	19	339	390	7 831	177	117
Unidentified egg 2	0	0	3	0	0	1	4	12	0	2	0	3	10	0	24	6
Unidentified egg 4	0	0	3	3	0	0	0	4	0	1	1	0	6	8	2	11

TABLE 5—*continued.*

	Station number															
	15	15N	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Engraulis australis	39	24	16	3	2	0	4	48	10	0	98	42	17	52	301	8
Sardinops neopilchardus	10	7	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Family Muraenidae	6	6	1	0	0	0	0	0	1	0	0	1	2	2	0	0
Gnathophis sp.	0	0	0	0	1	4	9	0	0	0	0	0	1	0	0	0
Zeus faber	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chelidonichthys kumu	4	4	8	0	4	0	0	0	0	0	0	2	22	0	7	5
Trachurus novaezelandiae	44	10	5 662	372	52	26	68	72	549	174	114	320	308	2 290	704	186
T. declivis	4	0	0	0	0	4	6	0	2	0	0	7	0	10	10	0
Arripis trutta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	0
Chrysophrys auratus	0	0	23	14	15	40	243	61	68	60	15	33	17	71	60	82
Family Labridae	6	1	16	0	0	2	0	0	0	0	0	0	0	0	0	0
Lepidopus caudatus	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
Scomber australasicus	10	1	16	3	30	8	4	0	15	4	10	82	0	19	13	14
Lophonectes gallus	81	97	70	33	0	0	0	4	2	7	1	61	134	29	3	5
Family Pleuronectidae	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Novodon convexirostris	25	21	101	28	4	28	18	108	32	28	7	43	62	52	53	49
Unidentified egg 1	4	6	85	0	6	32	50	10	5	493	66	179	50	43	23	0
Unidentified egg 2	2	1	47	11	23	26	13	13	0	2	0	0	0	0	0	5
Unidentified egg 3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Unidentified egg 4	0	0	39	5	4	10	1	0	5	0	0	0	0	0	0	5

*Night sample.

TABLE 6: Kinds and densities (number per 500 m^3) of larvae collected in the outer Hauraki Gulf, 13–16 December 1976

	Station number*													
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Engraulis australis	648	234	421	453	408	887	0	38	25	4	0	0	34	57
Sardinops neopilchardus	56	90	513	672	1 192	2 093	1 045	38	6	2	2	11	11	557
Family Moridae	0	0	0	0	0	0	0	0	2	2	3	0	11	0
Family Trachichthyidae	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Chelidonichthys kumu	0	0	8	0	31	13	0	0	0	0	0	0	0	0
Acanthoclinus quadridactylus	0	0	0	7	0	0	0	0	0	0	0	0	0	29
Trachurus novaezelandiae	407	162	812	380	769	1 033	95	38	0	8	2	2	103	29
Chrysophrys auratus	907	72	238	0	157	238	0	0	0	0	0	0	0	0
Aldrichetta forsteri	9	0	0	0	0	0	0	0	0	0	0	0	0	0
Family Labridae	0	0	0	0	0	0	0	0	0	0	0	0	0	86
Hemerocoetes sp.	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Families Blenniidae, Clinidae, and Tripterygiidae	9	54	352	51	345	66	0	0	0	36	8	34	126	486
Scomber australasicus	0	0	207	1 197	580	596	475	38	0	4	1	0	0	0
Lophonectes gallus	0	0	0	15	0	0	0	0	0	4	0	0	0	0
Rhombosolea spp.	65	0	0	0	0	0	0	0	0	0	0	0	0	0
Peltorhamphus latus	9	0	15	7	0	0	0	0	0	0	0	0	0	0

	Station number													
	15	16	17	18	20	21	22	23	24	25	26	27	28	29
Engraulis australis	33	737	465	60	9	85	50	8	0	66	187	427	1 029	2 842
Sardinops neopilchardus	148	175	296	345	28	145	20	8	0	37	112	1 320	1 243	1 319
Family Moridae	16	0	0	0	0	24	0	0	4	2	56	58	19	0
Family Trachichthyidae	0	0	0	0	0	0	0	0	0	2	19	0	0	0
Chelidonichthys kumu	0	0	0	0	0	0	0	0	0	0	19	19	0	0
Trachurus novaezelandiae	164	105	408	12	9	109	50	32	4	0	487	1 379	583	205
Chrysophrys auratus	49	70	42	0	0	24	90	8	0	0	0	0	78	88
Aldrichetta forsteri	0	0	0	0	0	0	0	0	0	0	19	0	0	0
Family Labridae	0	0	0	0	0	0	10	0	0	0	0	0	0	0
Families Blenniidae, Clinidae, and Tripterygiidae	16	35	28	71	0	36	70	32	8	37	169	1 262	78	147
Scomber australasicus	16	158	289	71	9	12	10	0	4	0	0	194	388	1 114
Lophonectes gallus	16	18	42	0	9	0	0	0	0	0	19	136	39	29

*Station 19 was not sampled.

TABLE 7: Kinds and densities (number per 500 m^3) of larvae collected in the outer Hauraki Gulf, 31 January–6 February 1978

Species	Station number 1	2	3	4	5	6	7	8	9	10	11	12	13	13N*	14	14N
Engraulis australis	62	181	78	206	338	7	144	20	0	0	20	13	17	0	183	252
Sardinops neopilchardus	0	0	0	0	0	0	18	0	0	3	0	0	0	0	0	28
Family Muraenidae	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Family Moridae	0	0	0	0	0	0	0	0	0	3	11	0	0	0	0	0
Cypselurus sp.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Scomberesox saurus	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Family Trachichthyidae	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	3
Zeus faber	0	0	0	0	0	0	9	8	0	0	0	0	0	0	0	0
Chelidonichthys kumu	0	0	0	0	0	0	9	0*	0	0	0	0	0	0	0	0
Acanthoclinus quadridactylus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0
Trachurus novaezelandiae	41	0	0	127	358	78	108	122	4	0	36	38	35	40	153	476
Chrysophrys auratus	0	26	31	95	40	3	0	0	0	0	0	0	2	40	0	112
Cepola aotea	0	0	0	0	0	0	0	0	17	17	4	0	0	0	0	0
Aldrichetta forsteri	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemerocoetes sp.	0	0	0	0	0	0	9	20	0	0	0	0	9	0	0	0
Families Blenniidae, Clinidae, and Tripterygiidae	10	0	0	0	0	0	0	0	0	0	4	0	0	0	61	0
Grahamichthys radiatus	0	0	0	0	0	3	18	0	0	0	0	0	0	0	0	3
Scomber australasicus	0	0	16	32	20	3	36	0	0	0	2	13	0	0	31	28
Family Gobiesocidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Lophonectes gallus	0	0	0	0	60	7	45	0	2	0	4	0	0	0	0	0
Rhombosolea sp.	0	10	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Peltorhamphus latus	0	155	47	0	0	0	0	0	0	0	0	0	0	0	0	0
Novodon convexirostris	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0

Species	Station number 15	15N	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Engraulis australis	62	16	350	13	62	211	203	45	24	0	27	61	685	500	413	493
Family Muraenidae	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family Moridae	21	1	0	0	0	0	9	0	0	0	2	0	0	0	0	3
Family Trachichthyidae	6	2	15	0	3	0	0	0	0	0	0	2	3	0	0	0
Acanthoclinus quadridactylus	0	0	0	39	0	0	9	0	0	0	0	0	0	0	0	0
Trachurus novaezelandiae	259	96	311	65	104	60	147	97	61	12	24	139	399	429	149	658
Caranx georgianus	0	0	0	0	3	5	9	0	0	0	3	0	0	0	0	3
Chrysophrys auratus	0	16	505	13	31	80	28	0	12	0	0	0	0	0	0	27
Cepola aotea	0	1	0	0	0	0	0	0	0	0	6	9	14	0	0	0
Aldrichetta forsteri	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Family Labridae	0	0	0	3	0	0	0	0	12	0	0	0	0	0	0	0
Hemerocoetes sp.	0	8	0	0	0	0	9	0	0	0	0	0	0	24	0	0
Families Blenniidae, Clinidae, and Tripterygiidae	0	1	0	91	0	0	0	0	0	2	0	0	0	0	0	10
Scomber australasicus	0	12	194	0	0	10	0	0	0	0	0	9	0	0	0	14
Family Gobiesocidae	0	0	0	52	0	0	0	0	0	0	0	0	0	0	0	14
Lophonectes gallus	83	4	0	0	10	90	129	0	12	0	0	0	14	0	50	55
Peltorhamphus latus	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0

*Night sample.

TABLE 8: Kinds and densities (number per 100 m^3) of eggs collected off east Northland, 26–30 October 1977

Species	Station number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engraulis australis	71	0	0	0	0	0	1	1	0	12	0	0	0	0	0
Sardinops neopilchardus	4 114	6	1	38	108	42	8	45	0	74	209	1 719	4	209	204
Auchenoceros punctatus	0	0	0	0	8	2	1	0	0	0	0	0	0	0	0
Chelidonichthys kumu	0	5	10	0	4	1	2	1	0	0	5	7	8	0	4
Trachurus novaezelandiae	464	45	81	60	362	16	24	10	1	76	559	364	4	2	4
T. declivis	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Chrysophrys auratus	0	0	2	0	2	0	2	0	0	17	382	2 142	16	6	7
Aldrichetta forsteri	5	0	5	0	0	1	19	2	0	0	0	13	0	0	0
Family Labridae	0	7	1	8	7	1	2	1	0	5	0	0	4	0	0
Coridodax pullus	0	4	0	0	0	0	0	2	0	0	0	0	0	0	0
Genyagnus monopterygius	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Lepidopus caudatus	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0
Scomber australasicus	91	33	7	111	146	7	10	17	13	22	40	66	12	1	0
Family Pleuronectidae	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pelotretis flavilatus	0	5	15	3	0	1	1	0	0	0	0	0	0	1	0
Novodon convexirostris	167	7	21	15	52	8	10	44	8	37	50	79	16	6	11
Unidentified egg 2	0	12	5	7	22	2	3	4	1	2	10	0	21	4	7
Unidentified egg 3	0	6	1	1	0	1	3	2	0	0	218	0	0	9	0
Unidentified egg 5	0	0	0	0	34	3	0	26	4	120	0	0	0	0	0

TABLE 8—*continued.*

	Station number														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Engraulis australis	2	5	2	17	0	0	0	0	0	0	0	0	0	0	0
Sardinops neopilchardus	5	0	6	65	16	3	35	32	0	84	1	0	0	0	0
Auchenoceros punctatus	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0
Chelidonichthys kumu	0	0	2	5	4	1	0	0	0	13	0	25	13	3	3
Trachurus novaezelandiae	0	21	2	7	21	3	35	0	0	0	0	0	0	0	6
T. declivis	2	0	16	0	0	0	0	0	0	0	0	0	0	0	0
Chrysophrys auratus	0	3	3	23	54	0	0	0	0	0	2	4	0	1	0
Aldrichetta forsteri	0	15	0	2	12	0	0	0	0	0	1	0	0	1	0
Family Labridae	5	5	3	4	0	0	70	3	0	4	0	4	0	1	0
Coridodax pullus	0	0	0	0	8	0	0	2	0	0	0	0	0	0	0
Scomber australasicus	0	0	2	2	0	0	0	6	0	4	6	3 432	4 039	487	32
Family Pleuronectidae	0	2	0	0	8	0	0	0	0	0	0	0	0	0	0
Pelotretis flavilatus	0	0	0	5	84	0	0	0	0	0	1	0	0	0	29
Novodon convexirostris	23	27	0	58	120	10	0	8	5	8	59	147	71	16	0
Unidentified egg 2	31	5	0	20	12	10	0	11	5	4	25	0	0	0	0
Unidentified egg 3	5	12	0	0	12	1	0	2	14	17	2	28	6	0	0
Unidentified egg 5	0	0	155	10	0	9	279	40	0	0	15	49	32	5	0

	Station number									
	31	32	33	34	35	36	37	38	39	40
Sardinops neopilchardus	7	0	3	0	0	1	6	0	9	43
Chelidonichthys kumu	0	0	0	0	4	1	0	0	0	1
Trachurus novaezelandiae	0	0	0	0	0	0	0	0	3	10
T. declivis	3	0	0	0	0	0	0	0	2	1
Chrysophrys auratus	0	0	0	0	0	0	0	0	5	11
Lepidopus caudatus	0	0	0	0	0	0	0	3	0	0
Scomber australasicus	10	0	0	0	0	0	0	0	0	6
Pelotretis flavilatus	7	0	30	3	13	0	0	0	0	0
Novodon convexirostris	3	3	0	0	0	0	4	0	3	16
Unidentified egg 2	3	0	0	0	0	0	4	0	12	4
Unidentified egg 3	0	3	0	3	13	0	0	0	0	1
Unidentified egg 5	214	23	9	9	4	1	4	1	71	9

TABLE 9: Kinds and densities (number per 100 m^3) of eggs collected off east Northland, 12–15 December 1977

	Station number*																		
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sardinops neopilchardus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Auchenoceros punctatus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Zeus faber	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chelidonichthys kumu	14	0	3	2	0	0	0	0	0	3	1	9	1	0	1	5	0	0	0	0
Trachurus novaezelandiae	76	31	30	34	3	20	18	16	3	20	10	658	12	8	3	1	4	0	0	2
T. declivis	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Chrysophrys auratus	52	71	7	15	3	0	2	0	0	3	4	68	0	0	0	0	0	1	0	2
Family Labridae	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Genyagnus monopterygius	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Scomber australasicus	0	2	2	2	3	0	0	1	5	0	1	2	23	4	1	0	0	0	0	0
Family Pleuronectidae	0	0	6	0	0	0	0	0	0	0	0	5	0	0	1	0	0	0	0	1
Pelotretis flavilatus	0	0	45	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Novodon convexirostris	40	34	26	21	16	3	22	13	3	4	2	14	13	19	16	0	1	0	0	2
Unidentified egg 1	0	0	0	6	0	0	0	0	0	0	98	14	0	0	0	0	0	0	0	0
Unidentified egg 2	2	6	7	11	7	17	45	7	3	4	3	9	8	6	8	5	11	1	1	1
Unidentified egg 3	0	0	1	0	0	5	0	4	0	0	0	0	1	1	1	0	1	0	1	3
Unidentified egg 4	0	0	0	0	0	0	0	0	0	1	0	2	2	0	3	0	1	0	0	0
Unidentified egg 5	2	0	0	0	0	0	0	0	3	15	36	2	0	0	0	0	0	0	0	0

	Station number																	
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	40
Paratrachichthys trailli	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Zeus faber	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Chelidonichthys kumu	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Trachurus novaezelandiae	0	0	3	2	2	3	1 580	16	1	1	1	0	2	1	2	0	0	0	1
T. declivis	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Chrysophrys auratus	0	0	0	0	4	17	6	0	0	0	1	0	0	0	0	0	0	0	0
Aldrichetta forsteri	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Coridodax pullus	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Lepidopus caudatus	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Scomber australasicus	0	0	0	0	15	3	195	11	1	0	0	0	0	0	0	0	0	0	0
Family Pleuronectidae	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Pelotretis flavilatus	0	0	0	0	1	1	0	0	1	7	0	0	1	0	1	0	0	0	0
Novodon convexirostris	0	0	0	20	5	5	24	0	1	0	0	3	0	0	0	0	0	0	0
Unidentified egg 1	0	0	0	0	0	1	10	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified egg 2	1	0	39	2	12	15	0	1	1	0	0	1	0	0	0	0	0	0	0
Unidentified egg 3	0	0	9	1	1	3	22	0	0	0	0	0	3	0	4	0	0	0	0
Unidentified egg 4	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Unidentified egg 5	0	3	0	0	0	0	24	3	0	2	1	0	0	0	0	0	0	0	0

*Station 39 was not sampled.

TABLE 10: Kinds and densities (number per 500 m^3) of larvae collected off east Northland, 26–30 October 1977

Species	Station number 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Engraulis australis	0	0	19	4	17	0	0	0	0	0	0	0	21	0
Sardinops neopilchardus	2 751	1 005	376	585	504	42	74	96	354	589	341	1 124	2 113	152
Family Myctophidae	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Auchenoceros punctatus	0	0	0	0	0	4	0	0	0	12	0	0	0	0
Family Moridae	0	0	0	0	0	0	0	0	0	0	0	0	21	0
Family Scorpaenidae	0	0	0	4	0	0	0	0	0	0	0	0	0	0
Chelidonichthys kumu	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Acanthoclinus quadridactylus	0	0	4	13	0	0	11	4	21	0	0	0	21	5
Trachurus novaezelandiae	25	9	4	9	9	0	0	0	28	110	0	66	18	0
Chrysophrys auratus	0	9	0	0	0	0	0	0	7	12	0	33	8	0
Family Labridae	0	47	8	28	9	40	16	9	42	49	0	331	410	47
Hemerocoetes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Limnichthys rendahli	0	0	0	0	0	0	0	0	0	0	0	0	8	0
Families Blenniidae, Clinidae, and Tripterygiidae	1 287	725	422	1 013	385	169	368	135	306	74	45	298	862	109
Grahamichthys radiatus	0	5	4	0	0	0	0	0	0	0	0	0	0	0
Lepidopus caudatus	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Scomber australasicus	25	0	0	4	0	0	0	0	7	0	0	0	0	0
Family Gobiesocidae	0	0	0	0	0	0	0	0	7	0	0	33	15	5
Lophonectes gallus	76	9	0	0	0	0	0	0	0	0	0	0	0	0
Rhombosolea spp.	0	0	4	0	0	0	0	0	0	0	0	231	21	0
Peltorhamphus latus	0	0	4	0	0	0	5	9	14	0	0	99	0	5
Novodon convexirostris	0	0	0	0	0	0	0	4	0	25	0	0	62	0

	Station number 15	16	17	18	19	20	21	22	23	24	25	26	27
Sardinops neopilchardus	714	611	121	551	136	722	294	2 130	2 488	736	8 484	799	579
Family Myctophidae	0	0	4	0	0	0	0	0	0	0	0	0	0
Auchenoceros punctatus	0	0	0	0	0	0	0	0	8	0	0	0	0
Family Moridae	18	0	0	0	0	0	0	0	0	0	189	17	0
Family Trachichthyidae	0	0	0	0	0	0	0	0	8	0	0	0	0
Hippocampus abdominalis	0	0	0	0	0	0	0	0	8	0	0	0	0
Chelidonichthys kumu	0	0	8	0	0	0	0	35	16	0	0	4	0
Acanthoclinus quadridactylus	0	0	38	0	17	41	6	17	72	46	0	33	0
Trachurus novaezelandiae	36	0	0	0	0	0	0	0	24	0	21	4	0
Caranx georgianus	0	0	0	8	8	41	0	35	96	0	232	17	175
Chrysophrys auratus	0	0	0	0	0	0	0	0	8	0	0	0	0
Family Labridae	161	206	106	32	8	103	6	0	8	0	0	4	18
Hemerocoetes sp.	0	0	0	0	0	0	13	0	8	0	0	0	0
Limnichthys rendahli	0	0	0	0	37	0	26	122	64	0	105	29	0
Tewara cranwellae	0	0	0	0	0	206	19	17	0	115	21	13	18
Families Blenniidae, Clinidae, and Tripterygiidae	946	473	636	688	242	495	268	332	528	621	379	234	70
Grahamichthys radiatus	0	0	15	0	0	41	0	0	8	23	0	0	0
Lepidopus caudatus	0	0	0	0	8	0	0	0	0	0	0	0	0
Scomber australasicus	0	0	0	0	0	0	0	0	24	0	63	25	17
Family Gobiesocidae	18	0	53	0	25	21	6	0	64	391	126	29	0
Lophonectes gallus	0	0	0	0	0	0	0	0	8	0	0	0	0
Rhombosolea spp.	0	15	45	0	0	21	0	0	0	0	0	0	0
Peltorhamphus latus	0	0	83	8	0	0	0	0	0	0	0	0	0
Pelotretis flavilatus	0	0	0	0	0	0	6	0	0	0	0	0	0
Novodon convexirostris	18	0	0	0	0	0	0	0	8	23	21	0	0
Allomycterus jaculiferus	0	0	0	0	0	0	0	0	0	0	0	2	0
Unidentified larva 2	18	0	0	0	0	0	0	0	0	0	0	0	0

	Station number 28	29	30	31	32	33	34	35	36	37	38	39	40
Sardinops neopilchardus	4 226	1 054	1 765	3 715	13 167	313	227	261	427	3 572	101	366	189
Family Muraenidae	0	0	0	0	0	0	0	11	0	0	0	0	0
Maurolicus muelleri	0	0	0	0	0	15	0	0	0	0	0	0	0
Family Myctophidae	0	0	0	0	0	0	0	5	0	0	0	0	0
Family Moridae	0	0	0	0	0	0	0	11	5	56	11	0	17
Family Scorpaenidae	32	0	15	0	0	0	0	0	0	0	0	0	0
Chelidonichthys kumu	0	0	0	0	0	0	0	0	0	0	0	9	11
Acanthoclinus quadridactylus	0	0	15	67	25	45	76	65	0	0	0	0	0
Caranx georgianus	161	177	235	318	547	149	91	109	63	205	53	0	39
Family Labridae	65	7	44	0	25	0	0	0	0	19	0	0	17
Hemerocoetes sp.	0	0	0	0	0	0	0	0	0	0	5	0	0
Limnichthys rendahli	65	0	0	17	0	0	76	141	0	28	11	0	11
Tewara cranwellae	129	0	0	0	0	0	15	0	0	0	0	0	0
Families Blenniidae, Clinidae, and Tripterygiidae	323	143	88	686	2 435	1 164	1 303	54	5	84	26	148	94
Grahamichthys radiatus	0	0	2	17	0	0	0	0	0	0	0	0	0
Thyrsites atun	0	0	4	0	0	0	0	0	0	9	0	0	0
Lepidopus caudatus	0	0	0	0	0	0	0	0	0	0	5	0	0
Scomber australasicus	0	20	15	33	0	30	15	0	16	90	0	0	0
Family Gobiesocidae	0	0	0	0	25	75	61	54	0	0	0	9	0
Lophonectes gallus	32	0	74	0	25	0	0	0	5	9	0	0	0
Novodon convexirostris	0	7	15	0	25	0	0	0	11	0	0	0	11
Unidentified larva 1	0	0	0	0	0	0	15	0	0	0	0	0	0
Unidentified larva 2	0	7	103	33	0	0	0	0	0	9	11	0	6

TABLE 11: Kinds and densities (number per 500 m^3) of larvae collected off east Northland, 12–18 December 1977

Species	Station number* 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engraulis australis	0	38	124	105	618	122	56	16	23	7	4	11	0	0	0
Sardinops neopilchardus	95	392	595	637	1 382	390	416	80	474	175	71	79	129	136	118
Family Myctophidae	0	10	0	0	16	0	0	0	0	0	0	0	0	0	0
Family Moridae	0	0	0	0	0	0	0	0	8	4	24	0	0	0	0
Chelidonichthys kumu	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0
Acanthoclinus quadridactylus	0	19	0	5	16	0	11	0	8	14	4	11	0	0	6
Trachurus novaezelandiae	18	10	25	11	0	0	0	0	15	4	4	0	0	0	0
Chrysophrys auratus	0	10	0	0	0	0	0	5	0	70	12	271	40	15	0
Family Labridae	6	38	62	16	65	37	22	48	0	0	0	554	50	29	10
Hemerocoetes sp.	0	0	0	0	16	0	22	0	0	0	0	0	0	0	0
Limnichthys rendahli	0	0	8	0	0	12	0	0	0	0	0	0	0	0	0
Tewara cranwellae	0	0	17	0	0	0	0	0	0	0	0	0	5	5	0
Genyagnus monopterygius	0	0	0	0	0	0	0	0	8	0	0	11	0	0	0
Families Blenniidae, Clinidae, and Tripterygiidae	59	268	413	316	650	220	483	174	211	42	20	531	139	510	446
Grahamichthys radiatus	0	10	12	11	16	0	11	3	0	0	0	181	0	10	25
Scomber australasicus	0	19	8	5	33	0	0	3	0	0	0	11	0	0	0
Family Gobiesocidae	0	19	112	58	16	24	79	8	45	28	0	34	0	29	67
Lophonectes gallus	6	0	0	0	16	12	0	0	23	0	0	0	0	0	0
Rhombosolea spp.	0	0	0	0	0	0	0	0	0	0	8	11	0	0	6
Peltorhamphus latus	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0
Pelotretis flavilatus	0	0	12	11	49	0	0	0	0	0	0	0	0	0	0
Novodon convexirostris	6	0	0	0	0	12	0	0	0	0	0	0	0	10	0

	Station number 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Engraulis australis	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Sardinops neopilchardus	6	39	25	140	161	5	309	615	48	68	107	41	5	12	7
Hippocampus abdominalis	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0
Acanthoclinus quadridactylus	4	31	0	12	4	0	0	311	48	6	4	10	0	0	0
Trachurus novaezelandiae	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0
Chrysophrys auratus	0	0	4	3	8	0	0	0	0	0	0	0	0	0	0
Family Labridae	4	0	4	2	117	0	0	0	0	0	0	0	0	0	0
Hemerocoetes sp.	0	0	0	0	0	0	2	37	0	8	4	12	12	0	0
Limnichthys rendahli	0	0	7	2	0	0	0	0	0	0	0	0	0	0	0
Tewara cranwellae	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0
Families Blenniidae, Clinidae, and Tripterygiidae	17	158	169	185	65	6	510	1 437	250	23	86	122	21	4	19
Grahamichthys radiatus	0	9	0	0	12	0	0	0	0	0	0	0	0	0	0
Scomber australasicus	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Family Gobiesocidae	2	18	7	22	4	0	0	37	0	0	6	10	2	0	7
Novodon convexirostris	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2

	Station number 31	32	33	34	35	36	37	38	40
Sardinops neopilchardus	4	0	0	0	0	0	0	0	0
Maurolicus muelleri	0	0	0	0	0	0	1	0	0
Family Moridae	0	0	0	0	0	0	0	0	1
Lissocampus filum	0	0	0	0	0	0	0	0	1
Acanthoclinus quadridactylus	0	0	10	3	0	0	0	0	0
Hemerocoetes sp.	0	0	10	3	0	1	0	0	0
Limnichthys rendahli	2	0	0	0	0	0	0	0	0
Tewara cranwellae	0	0	0	0	0	1	0	0	0
Families Blenniidae, Clinidae, and Tripterygiidae	4	140	72	45	20	0	0	0	0
Family Gobiesocidae	0	0	0	37	5	0	0	0	0

*Station 39 was not sampled.

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